June 1954 Senior Signal Tracer

Editorial

Page 42

THE Television Royal Commission's report, which at long last has appeared, has advanced us a step nearer TV. There is still plenty of ground to be covered before that first picture hits the air, but it is still a step. It is not likely now that anyone will wish to debate whether we will or will not have TV. In fact I think even those who for various reasons opposed it have read this recommendation with a certain measure of relief.

It seems certain, too, that whichever Government is returned, the advice in principle of the Commission will be accepted. There may be some points in the practical aspects of the matter which may need to be modified, but in general we may expect both national and commercial stations, with the large cities leading the way.

There will be many heartburnings and heartbreaks before that happens, however, particularly in the Commercial field. It is clear that the number of such licences is limited, and with more applications filed than there are commercial stations in the whole of Australia, who is to get them?

For that matter, does it follow that any commercial stations as such will get them at all? I doubt whether this point is implied in the report, nor in fact may it be practicable. It might even be a wise thing for commercial broadcasting interests to group their resources and apply for a licence on that basis, rather than compete for prizes which can only go to a few of them.

Despite the published views of some radio stations executives we will be scratching for some time to provide more than a few good TV programs. Far better to restrict hours, even drastically, than to fill in time with low-grade entertainment. That, of course, was in the minds of the commissioners when they considered how many programmes we could support.

How soon will it happen? Well, the report has yet to be considered when Parliament gets itself organized again, certain bills have to be decided upon in which the whole structure and the authority for its administration will be created, fees must be set, and plans laid. How long it takes to erect a station and get it going depends on many things; but I would be surprised if any official openings are held within two years.

In the meantime, let us have none of the idea that radio from now on is out. We've been over all that in past years. If you want a radio set, buy one. The TV proposition will be entirely separate. Your radio service is today as essential as light and power.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

Even operatives trained to assemble the tiny grids in modern valves must learn a new delicacy of touch when dealing with transistors. The photograph shows an operator, working under a magnifying glass, preparing to add the plastic cover.

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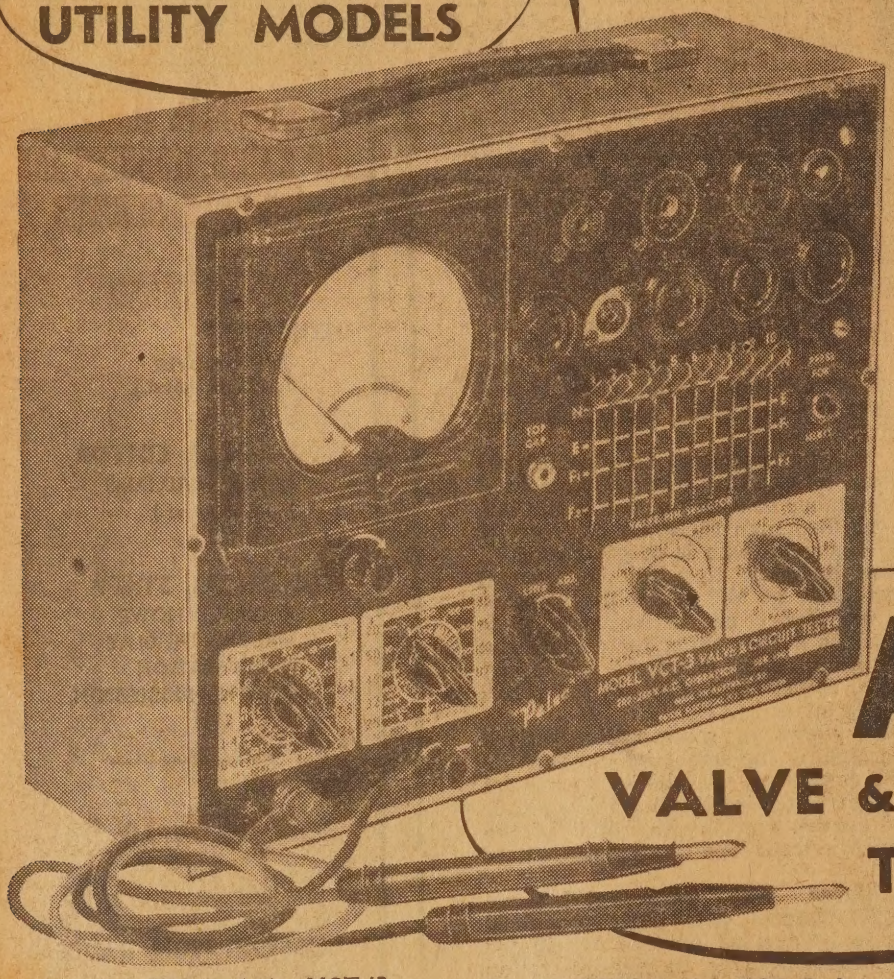

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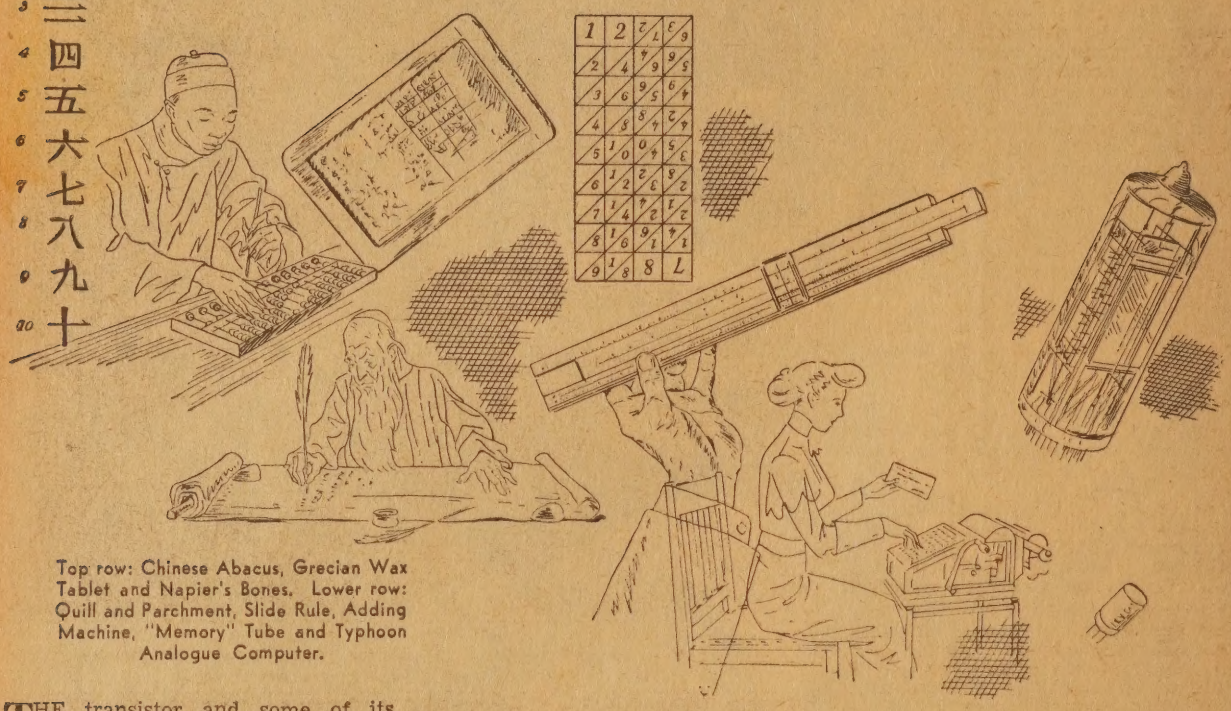
INDUSTRY'S EYE ON TRANSISTOR

A KEEN EYE, well magnified, and dextrous fingers are needed for the assembly of the transistors, especially when fine wires are mounted to the germanium specks. The outer plastic coatings are then added, cementing the assemblies in place and protecting the tiny devices against shock, vibration and moisture. See story on next page.

A New Era in Electronics



Top row: Chinese Abacus, Grecian Wax Tablet and Napier's Bones. Lower row: Quill and Parchment, Slide Rule, Adding Machine, "Memory" Tube and Typhoon Analogue Computer.

The early promise of the transistor is gradually being fulfilled but there is still much work to be done in design and manufacture. In this article Dr. Irving Wolff, of RCA, rates the transistor as a vital key to the amazing electronic computors which are revolutionary scientific calculation.

THE transistor and some of its companions in non-vacuum devices appear to have arrived at the right time to make practical some dreams which have been developing and gathering headway since shortly before World War II. I am referring to what might popularly be called a super-electronic brain.

EARLIER TYPES

The predecessor of today's electronic computer was first the abacus and later the office mechanical calculating machine which performed some simple arithmetic processes such as addition and multiplication.

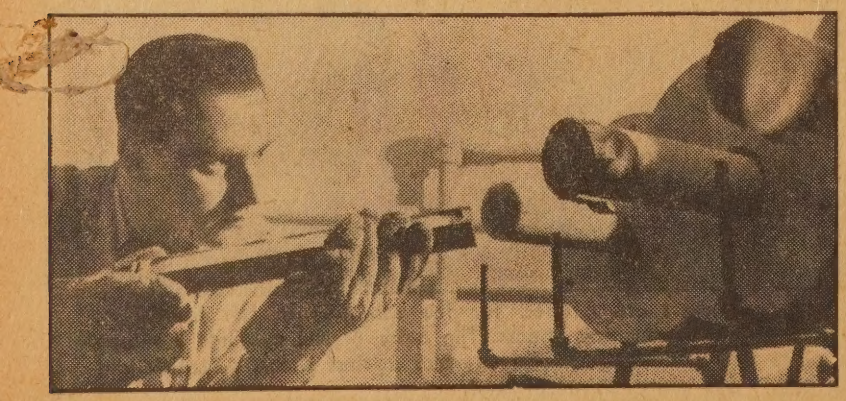
This was followed in succession by Vannevar Bush's mechanical calculator at the Massachusetts Institute of Technology which could solve some simple problems in calculus and, later, the early electronic computers using vacuum tubes which could solve the same type of problems more rapidly. Meanwhile, the number of vacuum tubes in each of these devices grew from one or two to a total of thousands. Special buildings were required to house these computers and air-conditioning systems were needed to take away the waste heat power of their tubes.

Our general concepts of the functions performed and the method of operation of these machines was becoming much better organised. We began to realise that the ability to store information (memory) was an important function of the electronic computer. We realised the analogy between the operation of the electronic machines and our thought processes.

Some machines have been built which can start in ignorance and can learn by trial and error, a method of learning which is used by many animals. We could see how to make the electronic machines many-fold more useful but the thought of putting in and maintaining the thousands of vacuum tubes required seemed fantastic.

NEW CONCEPTS

The advent of the magnetic and ferro-electric switches and memories and the development of the transistor have now changed our concepts of what is practical. We can foresee the time when we will not be staggered by the thought of a million or more



Trays of germanium powder are baked in a special hydrogen oven, where temperatures ranging up to 1050 deg. (centigrade) convert the powder into silvery metal ingots each worth about half the value of similar gold ingots. The ingots are then remelted, crystallised and purified.

electronic amplifiers or switches in a single machine. A recent test showed that the power consumption taken by the so-called counters in one machine could be reduced by a factor of 30—from 18,600 watts to 600 watts—by the substitution of early experimental transistors for tubes. This is only a start compared with what we will be able to accomplish within a few years.

What does this all mean in terms of the services that can be rendered by electronic computer equipment? At this time we probably see only a little of what is ahead. One thing is, however, apparent. We will be able to design equipment of enormously greater complexity than any that, up to now, has been considered practical.

I don't believe that the full impact of what the electronic brain will mean to our civilisation is generally realised. On the one hand it will act as a labor-saving machine in many business activities which use relatively unskilled clerical labor; on the other it will provide the individual with enormously greater mental power.

RAPID WORK

Just as a large scoop shovel gives the individual power to move tons of earth with the touch of a few controls—something which would have taken days to do by hand—so the electronic computer will permit the solution of problems in a few days which the individual would not have been able to solve during his lifetime.

For one hundred years or more we have been going through what has been called the industrial revolution. This has involved mainly the substitution of machines for manual labor in the production area. We have just scratched the surface in the substitution of machines for people in the mental and clerical areas of industry.

We can foresee that the new electronic computers will cause just as great a change in locations where large numbers of clerical workers are used, as the development of machines caused in the manual labor field. They can, for example, be used for automatic inventory control, cost accounting and billing. At present a system is actually under construction for the Ordinance Department of the army to provide complete stock control at one of their large bases. Large insurance companies and utilities are making analyses of the cost savings which may be obtained by electronising some of their clerical operations.

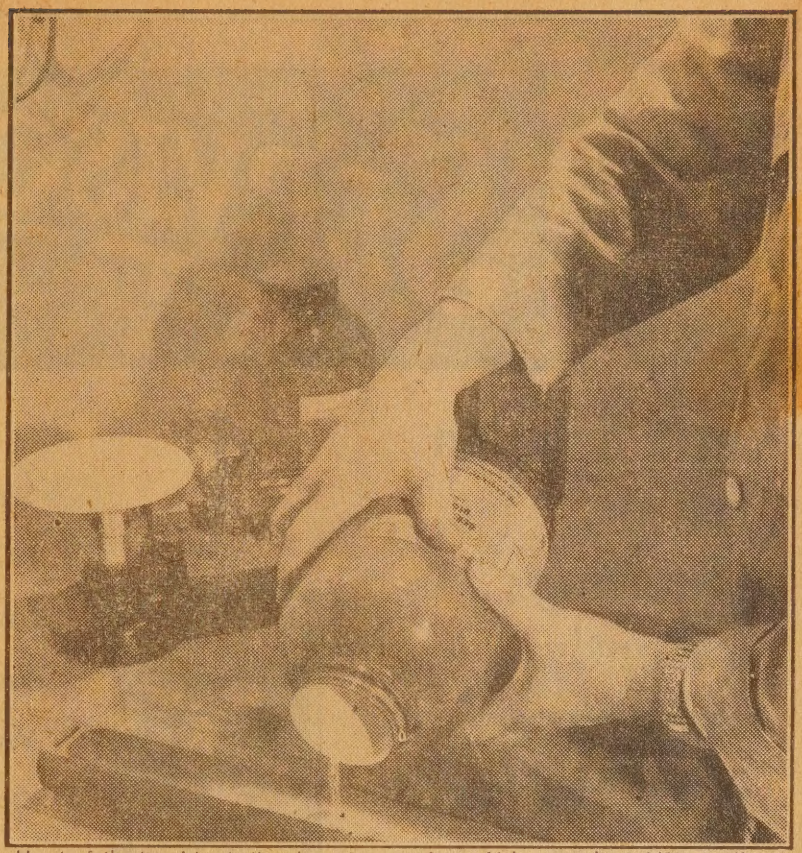
We can expect, however, that the greatest change in our way of life will result from the tool which the electronic computer gives us to extend our mental power.

I will illustrate this first with a rather simple, straight-forward example.

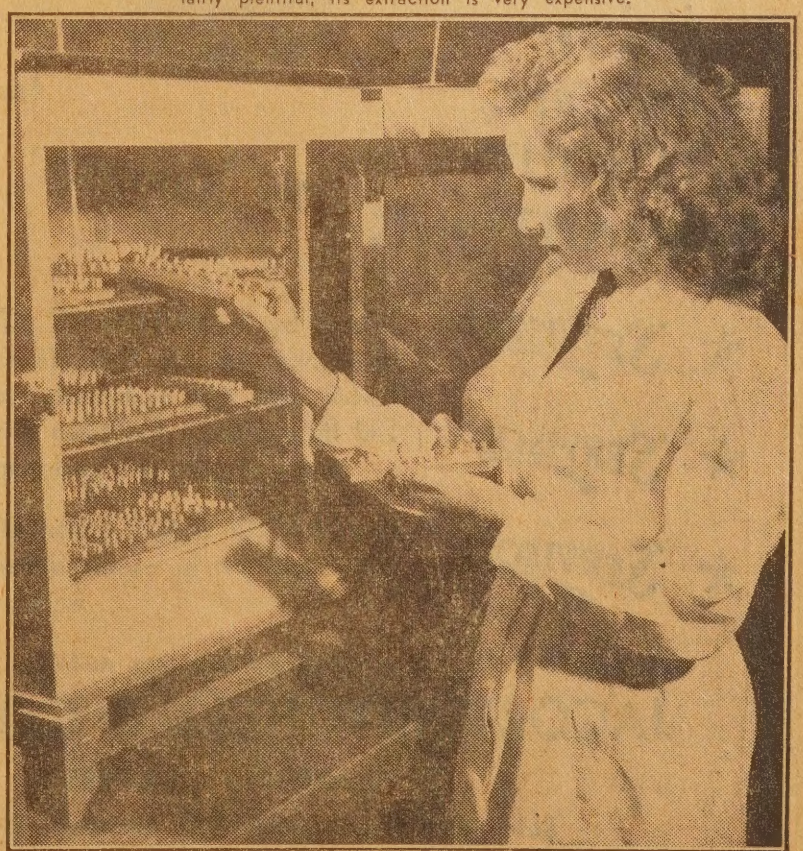
WEATHER PREDICTION

At the Institute for Advanced Study in Princeton, N.J., a computer using several thousand vacuum tubes has been built for the express purpose of giving us improved weather prediction. The physical laws underlying the flow of weather are, we think, reasonably well known.

The problem of assembling the data required to accurately compute the weather in advance and making the computations is, however, so stupendous that, using ordinary computer methods, the weather would be



Heart of the transistor is the element germanium, which costs about £400 per three-kilogram bottle in the powder form. Though the known quantity of germanium is fairly plentiful, its extraction is very expensive.



After the plastic coatings are put on, the tiny transistors are placed in an oven, where they are baked for 72 hours. When removed, they have a hard, glossy surface, and are ready for testing and use.

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long past before the calculations could be made. In addition, we must be able to check the laws we assume hold against the actual performance in order to increase the accuracy of our predictions. This requires many trial computations, each one of which would be terrifically involved.

The electronic weather computer solves both problems for us. (1) It enables us to make the difficult calculations we could not make otherwise, and (2) it permits us to make sufficient checks of performance against hypothesis to enable us to develop the hypothesis which gives the correct results.

As a concluding item, I will try to illustrate more completely what I mean by using another example.

Let us suppose that we want a machine to predict continuously the future price of some farm commodity. Such a machine might be useful to some government agency whose function it would be to stabilise the price of the commodity.

PRICE FACTORS

We can assume that the price at some future date is completely predictable with sufficient knowledge of the factors which determine price and the laws governing the interactions between them. Among other variables which must be introduced are certainly the supply of the commodity, factors which determine future supply, such as weather, planting, labor market, etc., the present and projected demand, including government operations, and others more subtle factors which determine price, such as the economic condition and mass psychology of buyers and sellers and the reaction of price changes on them, and last but not least, the eventual effect of the existence of the machine, which is doing the price predicting, on the price of the commodity.

I assume that the laws governing the interactions of the factors which are introduced will not be too well known when the machine is put in operation and that some rather wild guesses as to their characteristics will at first have to be made.

However, with any given input the computation will be made in a matter of seconds so that an enormous number of hypotheses can be introduced in a reasonable time, and the several predictions can be compared with the actual price to determine with fair rapidity which hypothesis gives the most accurate result.

NEW LAWS

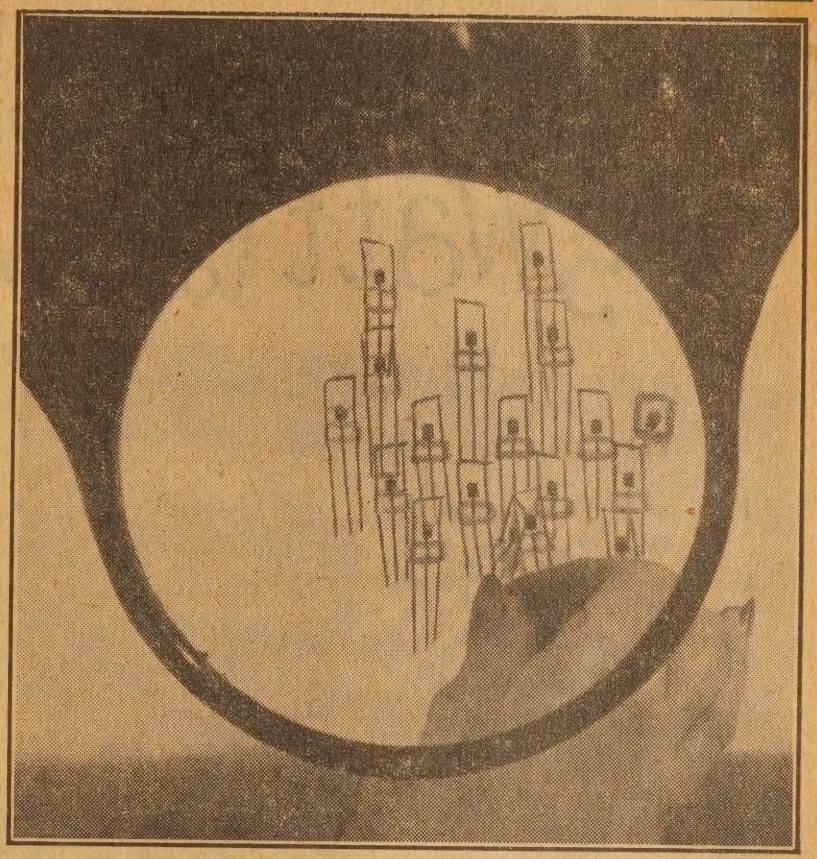
The electronic computer thus makes possible the same interplay between theory and experiment which has been so successful in determining the laws of natural science. In due course we would expect to develop a number of general mathematical laws which could be built on as the method is extended to more complicated problems in economics. You will note that the example I have chosen is a particularly simple one in that the correct experimental result is expressed by a single number—namely, the actual price at a particular time.

The analogy between the economic problem which has just been discussed and the weather-prediction problem is strikingly close. In both cases we must assemble at considerable expense and effort large amounts of data to put into the computation. In both cases the relations between the various data which have been gathered are complicated, and involved mathematical calculations are required in order to solve the problem.

In both cases, given sufficiently accurate primary data and knowing the laws which govern the phenomena, the desired result is certainly predictable and it is easy to compare the predicted result against the actual happening. The two problems differ in that the physical laws underlying the phenomena in the weather-prediction problem are reasonably well known while the laws underlying human behavior are still to be ascertained.

If an electronic computer using vacuum tubes can solve the weather-prediction problem, it is not unreasonable to hope that the vastly more erudite machine using the new products of our solid-state research will be able to solve the more complicated problems of the social sciences.

NO BIGGER THAN GREEN PEA



Transistor skeletons look tiny even when seen through a powerful magnifying glass. These just need their plastic overcoats to be complete.

NEW GRAPHS AID PLANE DESIGN

ADVANCE warning of how tomorrow's supersonic aircraft will face up to the formidable thermal barrier can now be obtained quickly from new graphs produced by a team of New York University research engineers operating under Air Force contract.
air force contract.

By studying and analysing a flat plate under known conditions, the research team has been able to draw up graphs which, with minor modifications, can be applied to aircraft surfaces.

These graphs will permit engineers to determine quickly the temperatures that will be encountered by aircraft flying as high as 100,000ft and at speeds of five times that of sound. At this speed, scorching heat is generated at aircraft surfaces due to air friction.

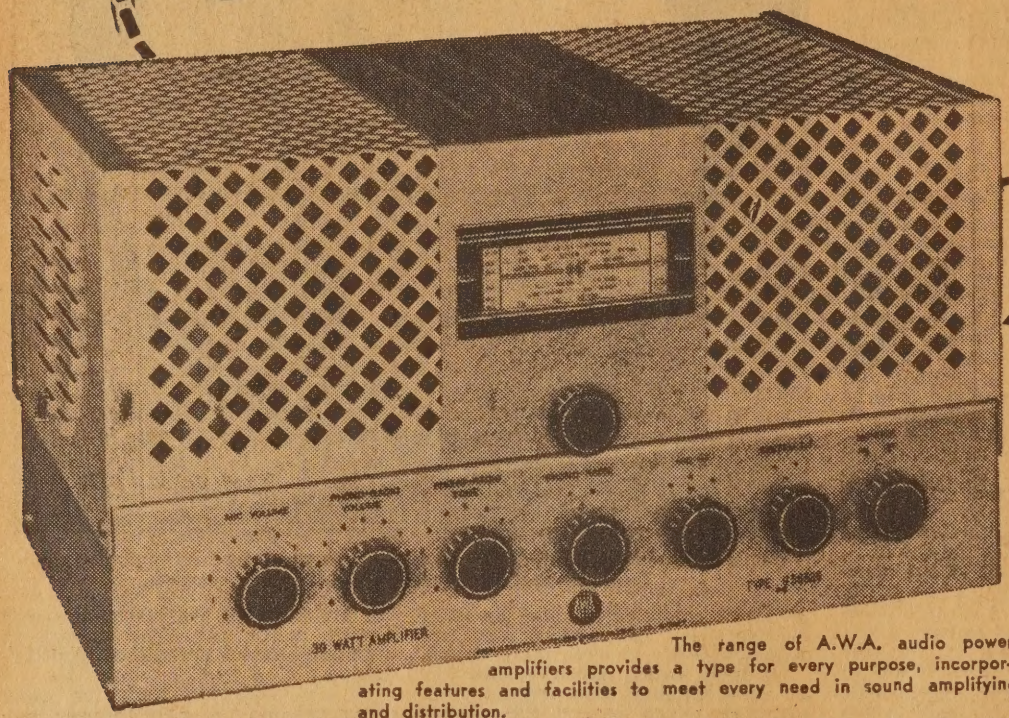
Called the thermal barrier, this frictional heat has become one of the aircraft designer's major problems. It is as imposing today as the sonic barrier was a decade ago. The heat affects not only the mechanical performance of the aircraft or missile, but also its fuel, interior equipment and human or automatic pilot.

The research team confirmed that to cool the total surface of an aircraft flying at five times the speed of sound would require as much refrigerating equipment as would be needed to air-condition a large building in the tropics.

AUTOMOBILE accidents have injured 26 citizens for each American serviceman wounded in all the wars ever fought by the US.

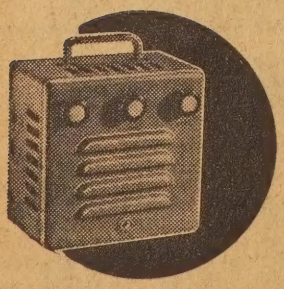
PUBLIC ADDRESS AMPLIFIERS

5 Watt to 70 watt



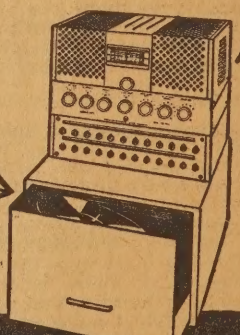
The range of A.W.A. audio power amplifiers provides a type for every purpose, incorporating features and facilities to meet every need in sound amplifying and distribution.

Designed and built to the same high standards of quality workmanship and performance for which the Company has established a world-wide reputation in broadcasting and communication equipment, models PA825 15 watt, PA826 30 watt and PA827 70 watt are illustrated above with radio tuner PA831 fitted. The amplifier protective cover has provision for mounting a monitor speaker.



5 watt portable amplifier type PA806 provides ample power for the needs of most indoor gatherings and many outdoor applications.

Radio, record playing, and speaker switching units assembled with the amplifier to form a centralised system.



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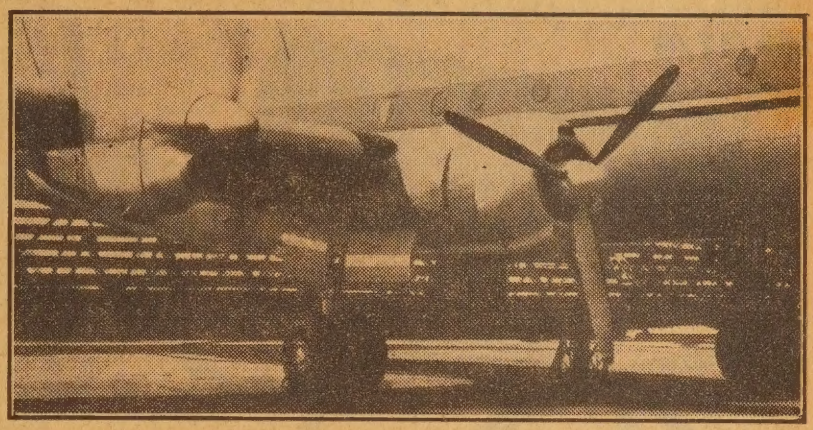
THEY TRY IT OUT ON "OLD 1961"

Around the Lockheed workshops in California, an old Constellation has become almost an institution. Everything new pertaining to Constellations, as well as a lot of other things, are tested on this flying laboratory. It was even cut and lengthened to become the first Super Constellation.



"Old 1961" has grown accustomed to carrying an assortment of engines. Here the T-56 turbo-prop is run up while its piston-drawn mate rests idly alongside it.

WHEN the laboratory plane goes aloft on a routine scientific test, a dozen crewmen don oxygen masks and heavy flying suits for greater comfort at altitudes where they operate their complex machinery. The plane has flown to about 29,000ft — more than a mile higher than Constellations or Super Constellations ordinarily speed between continents.

The experimental plane's history is so bizarre as to border upon the fantastic. It may resemble a modern fairy tale.

Built as a military transport and resold for possible commercial use, it has never carried a paying passenger nor ever flown a revenue route mile.

MILLIONS OF DOLLARS

As the first of its kind, it cost originally about 10-million dollars to build, and added scientific equipment has been loaded into the plane — all at extra cost.

In normal commercial operations it could earn substantial returns, reckoned in thousands of dollars a day. But nobody ever paid a dollar to ride in it or a dime to look at it.

Yet Lockheed Aircraft Corporation, the company responsible for building the plane, cutting it apart, putting it together, and flying it through intricate test programs at a cost that runs into thousands per hour, says that the plane has more than paid its way as a scientific tool for production of transports for the military services and the world's leading airlines.

It was the first Constellation ever built and the first to fly. It set a record of six flights on the very afternoon of its inaugural test.

TEST INSTRUMENTS

Immediately 1961 became the most completely instrumental plane of its day, with more than 200 instruments for its initial test program at Lockheed. Then it went through as rugged a program of evaluation as the US Army Air Forces could devise.

Ultimately the ship wound up as surplus government property and was sold to the Hughes Tool Co. During ownership by the Howard Hughes Co., the plane was kept at Culver City, California, and acquired scant flight time.

Lockheed, wanting a Constellation to convert into a Super Constellation to expedite changeover to the larger and faster transport series, bought the plane back from Hughes in 1950.

Turned into a scientific erector set of the air, "old 1961" was repeatedly modified and rebuilt to try out new ideas and new equipment — the Super Constellation proper, its early warning radar versions, big tiptanks, different engine and propeller combinations.

Here are typical tests: 17 tanks were scattered through the passenger cabin. Each tank contained 110 to 120 gallons of water when filled, and all were interconnected by 3in. pipe.

To change the centre of gravity in the plane, flight test experts shifted the load forward or rearward, simply by turning on a pump which shifted water from tank to tank.

They checked the plane in all sorts of combinations of speed, altitude and weight.

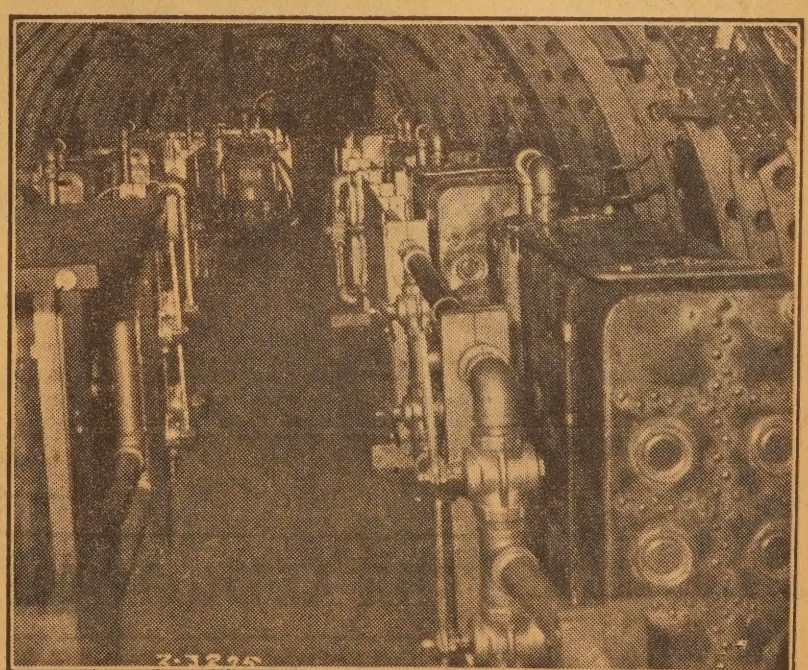
Besides changes in the centre of gravity, an important consideration in plane operation, engineers checked the difference between take-off and landing weights. (All current aircraft have different weights for these conditions; fuel consumed during flight naturally reduces the landing weight.)

To save time and fuel, flight crews loaded 1961 with water to take-off with a heavy gross load. Shortly afterward, they landed with 15,000lb less weight.

The simple expedient was to "burn water", pumping out water to equal the fuel that would have been used in a long-range flight.

Nothing escaped permanent record.

(Continued on Page 11)



Lush furnishings never graced the interior of this plane — just instruments and an ugly array of water ballast tanks.

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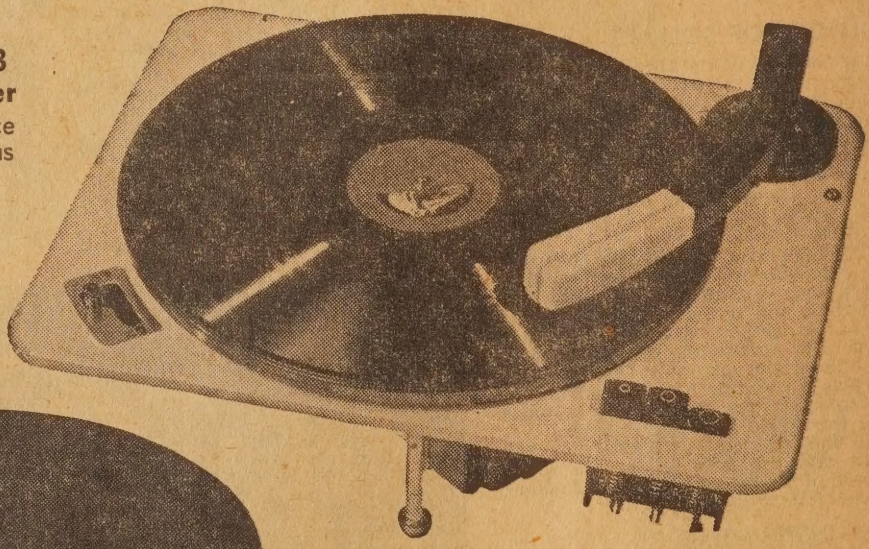

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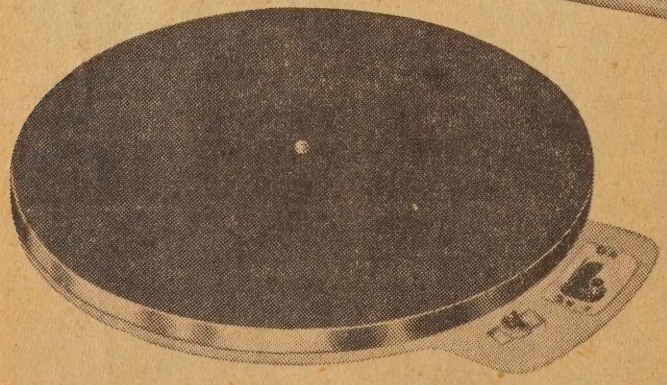

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FASTER THAN A FLASH OF LIGHT

Scientists in Britain have broken through a new barrier—if barrier it can be called. They have built a camera which works so fast that it can catch light as it moves at 186,000 miles (299,282 kilometres) per second.

By LEONARD G. RULE

THE camera was developed by Britain's Department of Atomic Energy, and it is now in use for photographing explosions. These explosions are very small—just laboratory "pops" — but through them the behavior of larger explosions can be studied. The camera captures light as it moves across a distance of six yards (five metres).

TYPICAL EXAMPLES

Think for a moment of all the things which happen "in a flash". The movement of the flash across the points of a sparking plug in a motor car engine, the travel of the flash of a short-circuit on high tension cables, a flash of lightning, and all kinds of other phenomena which we have accepted in times past just because they happened too quickly for us to do anything more.

With this new camera all these phenomena can be investigated.

We can find out why some sorts of sparking-plug work better than others; we can better understand the weaknesses of some kinds of insulation on electrical cables; we can probe deeper into the mysteries of lightning and other things which have so far baffled scientists — and ordinary human beings — by their sheer speed.

Clearly then, the masses of people throughout the world are going to benefit, sooner or later, from this device which atomic scientists have designed.

It was from the desire of physicists to know exactly what happened when they released the forces of nuclear energy in explosions that the new camera sprang. In their first efforts they followed, to some extent, the pattern of slow-motion cameras, which are, of course, anything but slow in motion.

Such cameras work so fast that they slow down the movement which they are photographing.

PRESENT PRACTICE

The basis of all this high-speed work is the Kerr cell, invented in Britain at about the beginning of this century by a Scots clergyman named Kerr. Out of his work has grown Kerr cell cameras which reached speeds of exposure and rotation far higher than anything known before.

Some years elapsed before the Kerr cell cameras emerged as practical instruments, but they have now reached speeds of 250,000 revolutions per minute, and an exposure time of one-tenth of one-millionth of a second.

It was cameras of this kind which were used to photograph Britain's two atom-bomb explosions. But still the cameras were not fast enough to meet the needs of the scientists whose ambition it was to watch light, as it were, on the move. They wanted to see the flash of an explosion as it spread.

The Kerr cell cameras had been improved by adding to them a ring of lenses which helped to avoid the "streak" effect noticeable in most high speed camera work. This ring of lenses made it possible to arrest for a minute fraction of a second the light which was focused on them, so securing a relatively stable image on 40 frames of film.

It seemed that with this development no further progress could be on those lines—at any rate, for the time being—and so the scientists turned their minds back to the older form of camera.

In their newest effort they have produced what is virtually a box camera, which exposes only one frame of film. But they have managed to speed up the exposure for that one frame so that it is five times as fast as their previous best. They have reached the incredible speed of exposure of one-fiftieth of one-millionth of a second.

The users can arrange a whole series of explosions, or flashes, and photograph the phenomenon a bit at a time, thus getting a whole series of pictures covering the entire life of the explosion, or flash.

One of the scientists who has been engaged in this work said, "It seems that we may have reached the ceiling now for speed. But the funny thing is that sometimes in research work the ceiling seems to lift a little higher. Perhaps we shall get faster pictures yet."

THEY TRY IT OUT ON "OLD 1961"

(Continued from Page 9)

On a hangar 1500ft from the runway at Lockheed Air Terminal, a 35-mm movie camera followed each take-off run. Its lens peered through a grid, properly marked to smale.

Rapidity of acceleration, altitude of the plane 10sec after take-off, attitude (position in relation to the horizon) of the plane during take-off, and a dozen other characteristics of each flight were marked.

Similarly, the grid camera recorded landings.

LANDING TEST

On one occasion, 1961 cleared a simulated 50ft obstacle, glided 1184ft, and rolled 987ft to a full stop — about 10 Constellation lengths.

In flight, motion picture cameras recorded every detail of performance as "automatic observers". Their shutters worked at intervals of one-half second to one minute, depending upon requirements.

One registered permanently the altitude, speed and position of all control surfaces. Others recorded the performance of each engine, vibration, stresses and temperatures. Special devices, for example, checked 144 individual temperatures on a single engine.

Throughout its history, the laboratory plane has undergone such arduous scientific testing in addition to those regular testing programs followed for each plane and each succeeding model, that the Constellation and Super Constellation probably have become the most thoroughly proven planes in current production.

Now, with Lockheed about ready to start flying its first turbo-prop powered C-130, a four-engine personnel-cargo transport for the US Air Force, "Old 1961" has graduated into the new realm of jet-propeller power in order to test the newcomer's engines.

A turbo-prop power plant has a jet turbine engine which turns a propeller.

The test plane is equipped with an Allison YT-56 in the No. 4 engine position outboard on the right wing. The experimental power plant thus becomes a primary part of the standard propulsion system, teamed with three piston engines.

Normally, such new power plant tests have been conducted by making the test engine a fifth unit, housed in some special and separate installation purely as an auxiliary, engineers explained.

Typical of "Old 1961's" mixed-up career, its piston engines are mismates — one a Wright turbo-compound of 3250 hp and two Pratt and Whitney R2800-C's of 2400 hp each.

The oft-rebuilt plane received a flashing new red and grey paint job to celebrate its turbo-prop ascent and to replace the wind scuffs and grease marks acquired in three years of heavy-duty test flying.

RECENT ADDITIONS

Among its more recent changes are a new aluminium skin and a larger and stronger tail like that of the Super Constellations which fly on the world's leading air routes.

By flying a C-130 engine on the laboratory plane, Lockheed will be able to keep its power plant experience ahead of that obtained in regular C-130 flight operations, which will be started in the near future.

Plans call for flight test engineers, under Chief Engineer Clarence L. Johnson and Chief Flight Test Engineer Rudy Thoren, to simulate C-130 power plant operations at varying altitude, climb, descent and range conditions.

Besides checking the engine, Lockheed has installed in "Old 1961" a duplicate of the C-130 engine control system and some of its main accessories.

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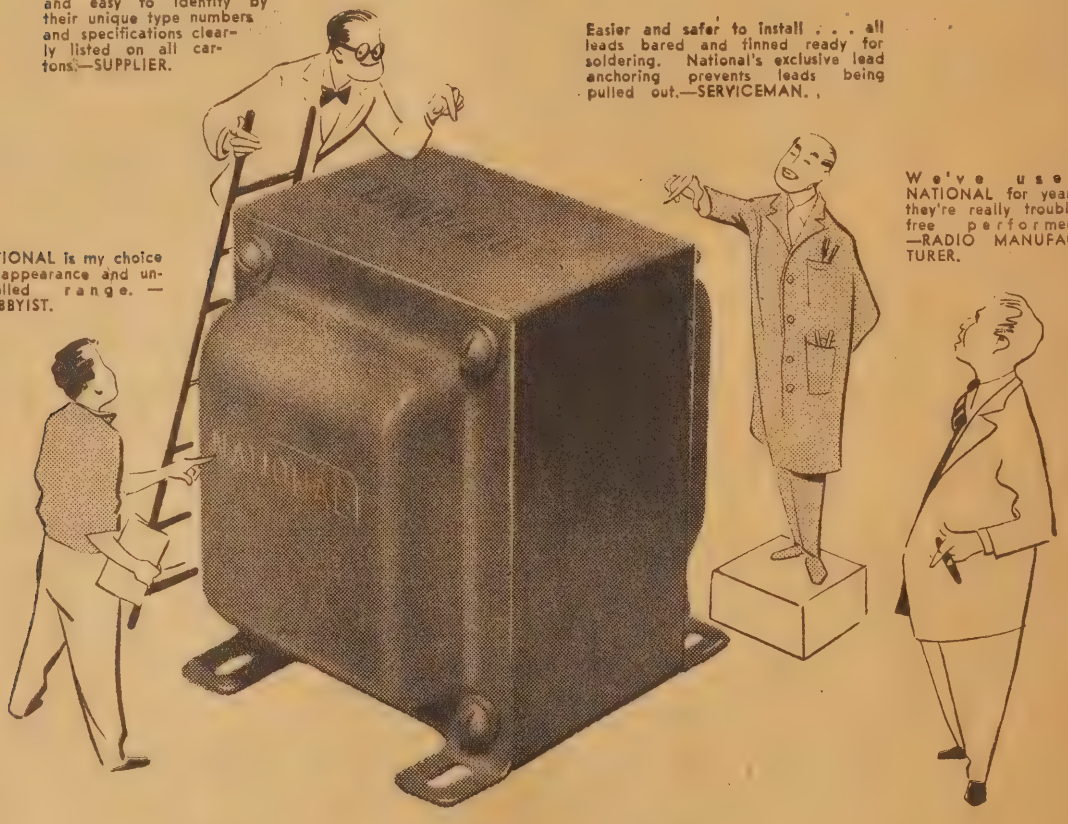

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SENSES GIVE LIFE ITS SAVOUR

Most of the actions of living things are governed by the exercise of the five senses: sight, taste, smell, hearing and touch. If you doubt it, imagine that you are out fishing in a boat on a lake. Think just how many of the senses come into operation without any conscious effort on your part.

FIRSTLY, you admire the view of the water and you peer into the distance at the spot, shown you by the local wiseacre, where you can always get a good haul. Here vision comes into play. You do not, of course, yet realise that you have been directed to that particular spot to get you as far away from the real fishing grounds as possible, so that the wiseacre will not be bothered with a "mug" fisherman.

SEA SOUNDS

You step into the boat and gently make your way up the centre. You do this very carefully so as not to rock it. You revel in the sound of the water lapping the sides of the boat or the cry of the seagull. Hearing thus plays its part but you hardly realise it.

You do not have time to, for a violent rocking of the boat heralds the entry of the wife and kids and all the lunch baskets! You stand erect and direct your efforts to balancing the boat. You do this quite naturally, because the equilibrium apparatus in the ear goes into action.

You finally get away and arrive at THE spot. You throw the kellick overboard, together with one lunch basket and the two or three fishing lines which have become entangled in the rope.

You then settle down and exercise your sense of taste from the demijohn. This special container is a most necessary part of the successful fisherman's equipment. I have taken a census and established that fishermen with no demijohn are just "fishermen" but fishermen WITH demijohns are FISHERMEN.

Having spent the best part of the morning putting hooks on the kids' and wife's lines, which incidentally exercises the sense of touch, you now scrape around the bottom of the boat for stray prawns, it having been discovered that the bait had been left on the wharf.

SENSE OF SMELL!

Here the sense of smell is strongly exercised and a few old leftovers are found in the bilge water These are used to bait the kids' and wife's lines and you can now spend the rest of the day guarding yourself from flying hooks and sinkers or removing hooks from the seats of pants and backs of coats or untangling lines and retrieving them from the water with an oar or pulling up the kellick and getting the hook off the rope!

A successful day's fishing ends with the emptying of the demijohn, the exercising of all the senses, a peaceful row back (sunburnt), all culminating with the boat bashing into the wharf and a mad rush by all to tell Mrs. Murphy about it!

This rather facetious but nevertheless true-to-life story is one illustration of the never-ending response of the human body to the influence of reflexes and irritations. It is a characteristic of all living things.

If the skin, the eyes or the tongue are irritated in any way, we experience the sensations of touch or pain, vision or taste.

We can bring about these sensations in a voluntary manner. In other cases there are irritations which do not produce sensations but have a reflex action. Such cases are instanced by the involuntary closing of the eye as a safeguard on the approach of a foreign body.

Again, the iris of the eye automatically contracts when a bright light shines into it. This latter is a very strong reflex action and cannot in any circumstances be controlled by the willpower.

Reflex actions are also instanced when an unexpected noise makes us jump or looking into bright sunlight makes us sneeze.

SENSE MECHANISM

Sometimes the smell or appearance of food or drink stimulates the flow of saliva as it probably did with the man and the demijohn. Bad food which may have passed through the taste barrier by some accident induces a reflex action in the stomach which ejects the food by vomiting.

Sensations and reflex actions are brought about by the irritation of what are known as receptors. These are located all over the body, outside and inside, which are ceaseless in their activity. They provide our central and nervous system with messages or impressions which are translated into sensations or reflex actions.

by Calvin Walters

These impressions make up our total mental existence and without them it would be impossible for us to think at all.

It is thought that voluntary actions are caused by impressions which take a longer path to the brain centres than those which cause reflex actions, because reflex actions are much quicker.

This is evidenced in the case of say a stone which is thrown at the eye.

If we are asked to wink the eye a period of about one sixth of a second elapses between the time the ear has picked up the request and conveyed the impression to the brain, with the subsequent translation into the action of winking.

On the other hand, if a stone is thrown toward the eye at a speed of 59ft per second and we relied on voluntary action to avoid being hit, the stone would have travelled about seven or eight feet in the meantime. Thus, if we did not see the stone approaching until it was seven or eight feet from the eye, it would hit us ere we could wink or get out of the way.

REFLEX ACTION

Fortunately this is not what happens. The action of winking or avoiding the stone in this case is usually a reflex action. We wink without any reasoning power from the brain whatever and this wink takes only one twentieth part of a second. So that if we suddenly see the stone when it is only three feet away we still have a very good chance to avoid it.

Thus a voluntary wink takes one seventh part of a second whilst a reflex wink takes one twentieth part of a second. According to R. W. Moncrief, who has investigated the problem, it proves that the messages must have taken different paths to the brain. He goes so far as to say that the reflex wink may have not come from the brain at all but rather to some place lower down in the central nervous system.

Of all the senses, perhaps those which play the greater part in the life of man and animal are those of taste and smell. It is not intended here to give a dissertation of the technical aspects of these two senses. Rather will we dwell upon some of the peculiar effects of them on life.

A question which is often asked is how animals know which food is good to eat and which is not. What food is poisonous and which is non-poisonous.

ANIMAL SENSES

We, as human beings, are not as expert in these matters as are the animals. Somehow through the ages man has found it out by experience, which he has handed down to his offspring. Thus, as children, we are told by our parents what to avoid.

The animals are in a different category in this respect for they have a much keener sense of taste and smell and they seem also to have an instinctive ability to differentiate.

In man and animals, the part of the nose where the organs of smell lie are impregnated with a pigment. This is yellow in man and dark brown in animals.

That this pigment has something to do with smell is indicated by the fact that animals which lack this pigment are more subject to poison-

(Continued on Page 17)

THE WOOD.—A huge pile of logs outside a paper mill at Ottawa—sixteen thousand cords of it. The overhead trolley line connects with the mill. This wood will eventually become newsprint.

HISTORY IS WRITTEN ON PAPER

Paper to most people implies a material used mostly for stationery, newspapers, magazines and books. But it is probable that little more than half the paper produced in the world is used for this purpose. The rest goes into products that we scarcely stop to think are just — paper!

by Prof. A. M. Low

IN 1948 about 75-million pounds of paper of all kinds were made; about one-third of this amount was used for wrapping and one-twentieth for an extraordinary variety of purposes, from covering walls to insulating electric wires.

The world's appetite for paper has grown year by year and appears to be insatiable. Production of paper has more than doubled in the present century and if present trends continue it may soon double itself again.

In the United States 5½-million tons of paper were used for printing newspapers last year, and the amount has increased by about 7 pc a year for some time.

NEWSPRINT SHORT

Other countries have not been able to increase their consumption of newsprint to the same degree, not altogether because there was less demand, but because there was no money.

There are still hundreds of millions of people in the world who can neither read nor write. As they learn, they, too, will demand newspapers, magazines and books.

It seems that, for any foreseeable time in the future, the production of paper for printing and writing will always lag behind.

At the same time the demand for paper for other purposes is increasing. Take the next biggest use of paper, boards and wrapping. Every year we ask for more wrapping paper, and we like the wrapping to be more elaborate.

In any large city thousands of tons of paper a year are used for paper bags to hold purchases, sheets of paper to wrap cheese, butter and meat before they go into the shopping-basket, paper containers to hold sugar, soap flakes and other things generally sold ready packed.

For an increasing number of articles the paper cover serves not only to wrap the article for cleanliness but to make it more attractive to the eye or to carry information about its use.

Paper is now being used for wrapping articles that previously needed sacks. Heavy Kraft paper sacks are used for holding all kinds of goods for transport, from cement to flour.

Now that the technique of making these containers immensely stronger has been mastered they have the advantages that fine powders cannot seep through to cause dust.

PAPER TOWELS

The estimated consumption of 700,000 tons of paper for use in "sacks" in the United States in 1948 shows how this application of paper has leapt ahead.

One look around shows how paper is tending to take the place of other materials. The chances are that the towel you use in a public washplace will be paper. You may even use paper towels in your own kitchen to save the trouble of laundering.

If you have a cold you can use paper handkerchiefs. When you go to the hairdresser he probably puts some special paper into your neckband instead of cotton-wool. If you travel on the railway you may use a paper pillow, specially made to be used once and thrown away.

Restaurants provide paper napkins instead of the linen of your youth; it is cheaper to use paper and throw it away than to wash a linen napkin.

In the United States paper curtains are coming into service for the same reason. The cost of a complete new set of paper curtains is only about four-fifths the cost of laundering a pair of cloth curtains.

Even string, by a new process, is being made from ordinary paper waste, not to mention such familiar things as filter paper, blotting pads and, unfortunately less familiar, the ordinary bank notes.

Paper, specially gummed, is re-

placing string for tying parcels and compressed paper in various forms, often treated with special plastics, is replacing wood and other materials for constructional purposes.

HEAVY TYPES

Paper is light, has good qualities of insulation for sound, heat and electricity and, when specially prepared, can be as strong as other building materials of equal thickness or weight. Paperboard, largely made from waste, becomes daily of increasing importance for constructional, boxing and allied purposes.

The chances are that the "art leather" binding of your book, looking so exactly like leather, is just paper. Your "fibre suitcase" perhaps not quite so hard-wearing as leather, but strong enough, is largely paper.

Plates and drinking cups of compressed paper as well as containers for milk, oil and other liquids, are becoming increasingly popular.

The advantages are lightness in comparison with glass or metal, the fact that paper cannot break and, above all in this labor saving world, that these new containers are so cheap that they can be thrown away after use instead of needing to be washed for use again.

The time may not be far distant when really attractive paper "crockery" can be made so cheaply that "washing-up" after meals will become a thing of the past. The housewife will just sweep the table into the garbage bin. Not, we hope, into the street!

ONCE PRECIOUS

Paper used to be very precious material. It was laboriously made by hand, sheet by sheet, from any fibres found suitable. It is still made in this way over great areas of China and in other parts of the world. Naturally, in such cases paper is a very precious commodity and never thrown away, but used again and again.

Until the Japanese invasion surprisingly enough, China was the biggest importer of paper in the world — not for printing, but waste paper, mostly out-of-date newspapers which were used for purposes never dreamed of by those who first read these journals.

Applications included preparing the interior of houses to insulate them, making toys and wrapping anything and everything. In Chokiang alone it was estimated 200,000 people lived on selling articles made from wastepaper.

About the only paper burned was in the form of "mock money" at funeral services to ensure that the deceased would be able to purchase anything he required in the next world.

TOUGH FIBRES

We in Britain are not so careful of our waste. During the war we made a great effort to collect it, but now the amount being burned and spoiled is increasing as we return to our old prewar wasteful ways when we throw away about 1½-million tons of paper and cardboard each year worth about £3½-million at the time and twice as much or more today.

A TANK FULL OF LIQUID PAPER

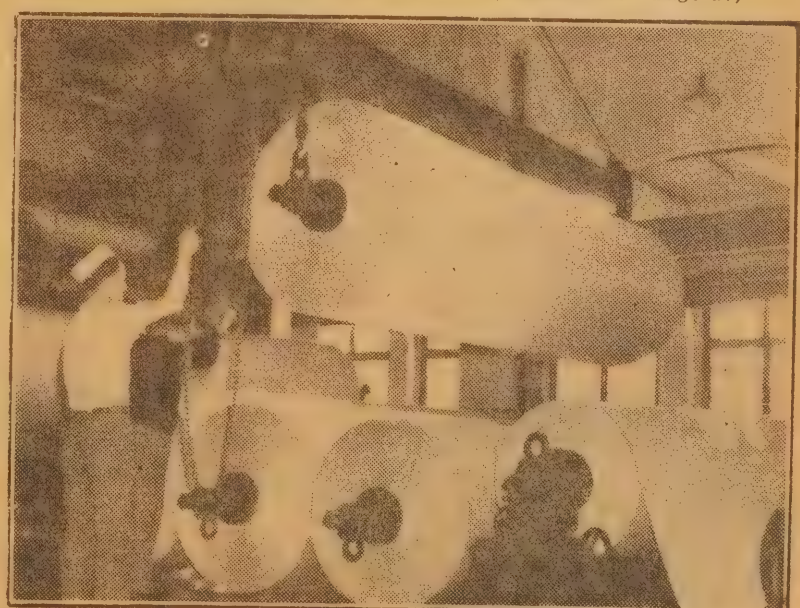
THE PULP.—This soft mushy mess is the next step in paper making. Many materials other than wood are used according to the class of paper required.

The astonishing thing about paper is that it contains fibres which are virtually indestructible.

You can tear the paper up into small pieces, wet it so that it tears at a touch, but treat the fibres, pulp the spoiled paper, and roll it out and we have an almost new material that can be used again. The fibres that make paper possible remain.

It may not be practical or profitable to remake the paper into its precise original form. This would mean sorting all the waste according to its type, and the use of manufacturing processes even more elab-

(Continued on Page 17)



THE ROLLS.—The smooth, even rolls of paper are shipped from the mill to the news presses of the world. A good deal of Australian newsprint comes from a fine mill in Tasmania. The rest of it goes into products for industry and the home which we rarely think of as paper.

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SENSES GIVE LIFE ITS SAVOUR

(Continued from Page 13)

ing that those with it. White animals are in this class.

In some parts of the world where poisonous weeds and roots occur, farmers will only breed black pigs because the white pigs eat and are poisoned by the weeds which black pigs will not touch. The same applies to black sheep which are bred in some parts of the world for the same reason. It is significant that the white animals are lacking in the olfactory pigment.

Charles Darwin gave as his opinion that both animals ate the same food but only the white ones succumbed. Later investigation proved that only the white animals ate the poisoned food.

ASSOCIATIONS

A peculiar aspect of the sense of smell in man lies in the fact that he can develop what might be called an "association reflex" for want of a better term.

For instance certain odours are caused by partly decomposed food such as cheese or poultry. These are considered appetising in these two articles but put an egg in front of him with the same odor and he will be nauseated by the smell.

Who does not like the smell of roast beef? Associate the smell with the actual beef, and it is pleasant and appetising. There is a plant, however, which goes by the name of iris foetidissima, and which has the same smell. It is considered nauseating.

The same can be said of onions and garlic. Considered alone, the odor from these is not pleasant. But considered in relation to salads the effect is quite different.

There are also such things as conditioned reflexes. If we are hungry, the smell of good food will often stimulate the salivary glands and the secretion of stomach juices, so that the stomach will be ready for the digestion of food. This is an ordinary reflex.

CONDITIONING

If, however, an animal is always fed when a bell is rung there will come a time when its salivary juices will flow when the bell is rung, even if no food is given. This is a conditioned reflex.

The same sort of thing happens to people by the itching of the palm on pay day, over long years of association, or the association of the knock off bell with the grabbing of a hat and the run to the corner pub. Some people get tired on Monday just because it is Monday, not because they are tired.

For the benefit of the fisherman whose story opened this discussion it might be mentioned that a sole has no power to recognise a worm hanging over its nose. It certainly can see it, but, only for the sense of smell it might be a piece of string. The sole feels for it by the sense of smell.

A similar characteristic is possessed by the cat. One can place a piece of meat right in front of its eyes, but the cat still insists in searching for it by the sense of smell and will only eat the meat after it has located it in this way.

In passing, it is amusing to recall how odors were used in ancient medicine. In those days it was considered that disease was due to a demon having entered the body of the victim. In order to drive this demon from the body recourse was taken to the burning of all kinds of substances such as hair, sulphur, bone, horn and anything which would produce a nauseating stink, around the patient.

TASTE AND SMELL

Success of the treatment was, of course, its justification, while failure was no doubt due to the fact that the demon preferred to remain inside the victim, safe from the entry of the vile smell without.

The sense of taste can hardly be dissociated from that of smell. In order to taste we must smell. Now don't misunderstand me. I mean our olfactory organs inside the nose must function. Hold your nose while you eat, and, unless you recognise what you are eating from the look of it (which is very doubtful in some eating houses I have been in) then it will have no flavor. It will be merely bitter, sweet, saline or sour, which characteristics have nothing to do with the odor sense.

It is fortunate that food has flavor and not just bitter, sweet, saline or sour. Fancy having a handful of salt for breakfast, a plate of sugar for dinner and a dish of lemon juice garnished with quinine for supper.

It is the flavor which stimulates the flow of salivary and digestive juices and thus does useful work in this way, in addition to making eating a pleasure.

That is why people who have a bad cold in the head cannot enjoy a meal and frequently have no desire for food. The stuffed up nasal passages render the olfactory sense inactive by preventing the passage of air. Thus, the necessary combination of smell and taste is not there and eating becomes more of a bore than a pleasure, because there is no flavor detected in the food.

Thus, it is we see that man does not live by bread alone. He also lives by the exercise of his senses, without which he would be a helpless individual. Especially does he rely on his sense of smell and taste. He could get along in a kind of way, and many do, without his sense of sight or hearing. Deprived of these two he can still smell, taste and feel. These three are his mainstay in his fight for self preservation and the continuity of the species.

HISTORY IS WRITTEN ON PAPER

(Continued from Page 15)

orate than those required for making paper from wood-pulp. But the paper can be remade into wrapping, cardboard, fibre-board, and all types of articles of which we have need.

Remade paper is perfectly satisfactory for most purposes, and its use helps to save the more expensive raw materials which can then be applied to newsprint or writing paper.

Reusing paper means far more than having money, although that is a consideration. It means that valuable fibres are conserved. The fibres come from many plants, mostly softwoods, but there is only a limited supply in the world.

The chemist with all his success in synthesis has not yet been able to make artificial paper.

The fibres which become paper owe their shape and strength to the fact that they are of very large and complex molecules which cling together, and these are not easy to build up from simple substances like the chalk, air and water so often used for synthesis in the laboratory.

Our paper supply depends upon plants, and is likely to do so for a great many years to come.

The natural substances in demand for making paper, particularly wood-pulp, are also in demand as the raw materials for other industries. All textiles depend upon fibres; and rayon uses as its raw material much the same main material as paper—wood-pulp.

Because of the limited amounts of such fibres as wool, cotton, hemp, flex and jute, available for textiles, the demand for synthetic textiles has risen every year and with it the demand on the raw materials which are also needed for paper.

In many ways paper and textiles are competing industries; they not only compete in the finished products, as in the instance of string and gummed paper, but for the basic raw materials.

Other raw materials used in paper-making are esparto grass, straw or cotton, linen, hemp and jute fibres. Each has its special purpose for special types of paper.

With the constantly increasing need for both paper and textiles the difficulties of limited raw materials will become greater.

It is true that far more wood is used for fuel and furniture making or housebuilding than for making paper or textiles, and that we can effect great savings by using other more economical fuels and by developing metal alloys in place of timber.

It is also true that new and more efficient methods of pulping are giving a greater amount of paper or textile from a given amount of wood, although there are limits beyond which we cannot go in this direction at present.

But there are few limits to the extent to which we can reuse paper. Every scrap of paper from the solitary bus ticket to the soiled parcel wrapping can be used again after treatment, perhaps appearing as a cardboard box or the heel of a woman's shoe, in artificial leather.

The time is coming when we shall have to give much more attention to saving paper, not only as a matter of financial economy, but because paper burned or ground into the mud of the street means fibres lost for ever, and these are the precious fibres which cannot be grown fast enough to replace the world's very urgent requirements.

Life without modern paper would lose immeasurably in amusement, comfort, safety and health.

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Technical Review

NUCLEAR BATTERY WITH 20-YEAR LIFE — PERHAPS!

At a recent Press conference in New York, Brigadier-General Sarnoff of RCA announced that his company had developed a practical nuclear battery which appeared to have enormous possibilities. Shortly afterwards, Michael Amrine, former Managing Editor of the Atomic Scientists Bulletin, said that the RCA battery was neither a very new idea nor a very practical one.

AT his Press conference Brig.-Gen. David Sarnoff, RCA board chairman, said RCA experiments indicated the possibilities of thimble-sized atomic batteries which may be developed to a commercial stage so that they will supply power for radio receivers and other kinds of apparatus for at least 20 years.

He said the development could prove as significant as Edison's conversion of electricity to light and said the RCA battery is a "major breakthrough" toward converting atomic radiations to electricity, a goal sought by science for 40 years.

Gen. Sarnoff said within three months RCA has raised the battery's output from a billionth to a millionth of a watt, through coupling the battery's radioactive source to a transistor-like wafer which instantaneously releases some 200,000 electrons for each electron it receives.

He said it is possible that one small container eventually might become the full power source for the American home.

HOW IT WORKS

Dr. E. W. Engstrom, executive vice-president in charge of the RCA labs division, said the battery contained the radioactive source and a wafer of semi-conducting crystal.

The power source used in the RCA battery is a minute quantity of a long-life strontium-90 radio-active isotope obtained as a by-product of atomic reactor operation.

In the RCA battery 1-300 cc of strontium-90 is spread in a thin layer against the wafer, which is alloyed with an impurity material to form a junction.

The wafer is bombarded with several billion electrons a second, which as they penetrate release 200,000 low-speed electrons for each bombarding electron.

These low-speed electrons flow across the wafer's junction, providing a voltage low enough to be applied to an electronic circuit and cause a current to flow.

This is called an electron-voltic effect, and never before has been put to practical use, Dr. Engstrom said.

The battery provides a current of five microamperes and has an output of about a millionth of a watt.

Since the best efficiency of energy conversion to date exceeds 1 pc, Dr. Engstrom said 1-100th of the energy of the beta particles as they leave the radioactive source is turned into electrical power, the rest being lost as heat.

He said a refinement of present methods should increase efficiency to 10 pc.

Increasing the strontium-90 or placing a number of the 50 millicurie units (such as that used in the battery) can achieve greater power, and about 10 such units could operate a transistor-powered radio, he said.

Although almost any radioactive material could be used in an atomic battery, RCA used strontium-90 because of its high energy beta radiation, its long life, low shielding requirements and its availability in experimental quantities from the Atomic Energy Commission.

CLAIMS DENIED

Such was the story told by the RCA representatives, and there could be no doubt that a battery with a 20-year service life would revolutionise electronic design.

However, it is obvious that a good many scientists are far from convinced that RCA has presented the world with a revolutionary idea.

Says Michael Amrine, "Scientists fear the public has been misled into thinking 'atomic batteries' are 'just around the corner' when, actually, many problems must be overcome."

The method announced by RCA is a way to do it, all right, but it is not a new way, and it is not practical. The publicity said the atomic battery "is expected to take its place alongside giant nuclear reactors as an important new source of packaged electricity . . ."

An AEC researcher said: "The only thing new about this development is the quality of the publicity. A similar gadget was developed over two years ago."

The announcement in New York mentioned, but failed to emphasise, that the fundamental process involved—direct conversion of radiation to electrical energy—was not new. The emphasis was on the fact that a new use of additional material with the radioactive material made it possible to get much more electricity than previously. It was reported that "the electric current generated by this new method is about 200,000 times greater than has ever before been attained from experimental conversion methods".

MINUTE QUANTITY

This sounds like a great advance, and technically it is, but practically the energy involved is so small that, in the words of one scientist, "two hundred thousand times nothing is still nothing".

The atomic battery, with the new development which RCA has put on it, develops an output of one-millionth of a watt. As recently as three months ago, the battery's highest output of power was one-billionth of a watt, so it was felt that further increases in power will be made. At present it converts only 1 pc of the energy available in the electrons leaving the radioactive material. This is far below the conversion rate which a nuclear reactor has for the production of usable power from the heat of the chain reaction.

A scientist said these atomic batteries had been used for some time in military devices, where they can be useful in "triggering controls".

He termed "unlikely" the claim that they could some day be used to run refrigerators, heat the average home, and so forth. "It is this kind of story which makes the public gullible and willing to believe all sorts of nonsense about atomic power," he said.

COSTLY "FUEL"

Another subject for comment is the statement that since the radioactive strontium from which the original energy comes is found as a waste product of nuclear reactors, the battery's source material eventually is bound to be very cheap. The hard fact is that processing the waste material—the atomic ashes from a nuclear furnace—is an extremely expensive job. The strontium in the battery today is going to cost about 25 dollars, and that is a lot to pay for a battery giving off one-millionth of a watt!

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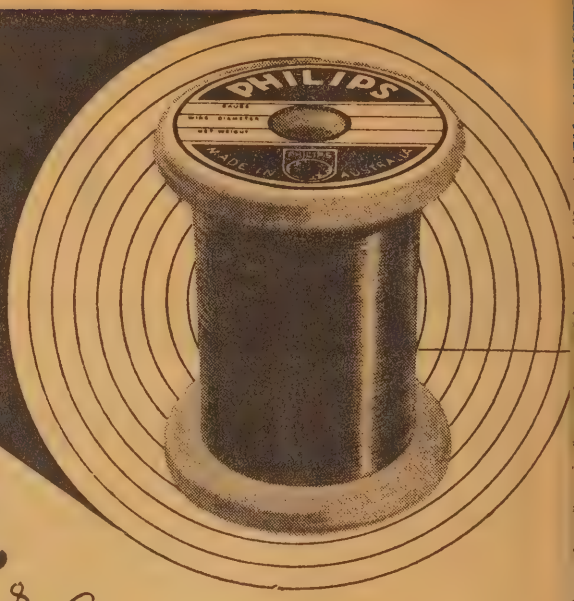

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TINY JET SHAPES CRYSTAL FOR NEW TRANSISTOR

The most intensive efforts at the moment are being directed to solving the problem of the transistor — how to produce them cheaply and in quantity, while maintaining uniformity of characteristics. A new method of construction has recently been announced by Philco, in America.

SINCE the transistor was first developed as a practical device, many techniques for producing them have been evolved. While these have allowed limited production to begin, the search still goes on for methods which will speed and cheapen the process, while ensuring greater uniformity in electrical characteristics.

The technological problems of constructing the germanium sandwich are, like the problem of getting the jam into the doughnut, extremely difficult.

The central layer must, like the jam, be extremely thin and methods used so far have not been very successful in achieving the required uniformity except for relatively thick base layers, with the corresponding limitation to low frequency operation.

A new type of junction transistor has now been announced by Philco in America, in which many of the difficulties are overcome. In some ways this new transistor reminds us of the coaxial point transistor described by Knock and Wallace.

TINY DISC

The coaxial transistor consisted of a disc of germanium one-eighth of an inch in diameter and 0.02in thick, in the faces of which two concave depressions were ground.

The point contacts were applied coaxially, one fitting in each hollow. It seemed quite a good idea, but no more has been heard of it.

The surface-barrier transistor is also made from a small plate of germanium, cut from a single crystal of n-germanium and initially 0.05 x 0.10in in area and 0.006in thick. Since the cutting operation damages the crystal structure, the small blanks are etched to a thickness of 0.003in, and a nickel contact tab is then soldered to one end.

This slab of germanium is still far too thick, and the working section must be reduced in thickness. Here we meet Part 1 of the new invention. Jet electrolytic etching is used to dissolve away some of the germanium.

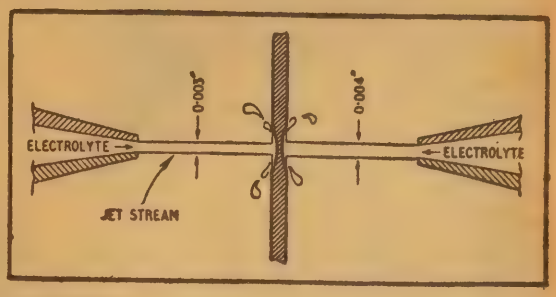


Fig. 1. Etching of germanium wafer by jets of electrolyte.

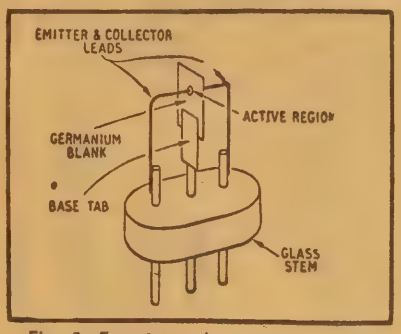


Fig. 3. Experimental mounting for surface transistor.

Fig. 1 shows how two jets are played on opposite sides of the germanium blank from glass nozzles about 0.005in in diameter. The jets are a solution of an indium salt, and a current of about 1.5 mA is passed along the jets and through the nickel tab.

Light must fall on the jet-germanium junction during the etching process, because the current is flowing through the back resistance of the jet-germanium diode, and it turns out that the effect of these combined conditions is to make the window flatten out as it gets thinner.

This helps to give good high-frequency performance.

A hole is first drilled right through, to find out how long it takes on the particular blank being processed. Then the blank is removed, and the etching process carried out, stopping when calculations show it must have left a window about 0.0002in thick. This takes rather under two minutes.

The current through the jet-germanium diode is now reversed, so that the system becomes an electroplating unit. Indium is deposited on the surface of the germanium, and the layer is built up to give an electrode thickness of 0.0005in.

Wires are fastened to these two electrodes and the unit is mounted and sealed.

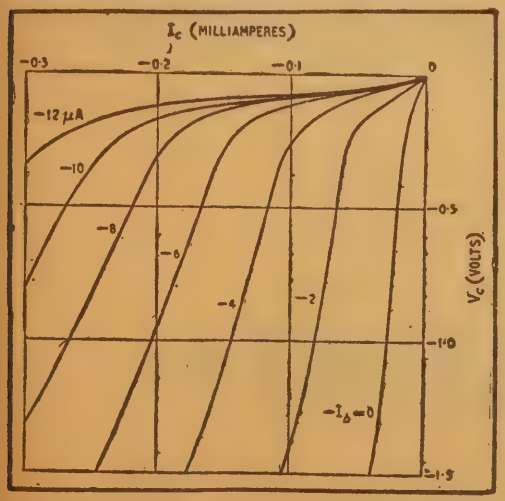
There is no forming action, no heating to produce diffusion. Here we see the fundamental difference between the transistor which results from this method of manufacture and the transistors we have encountered before.

WELL DEFINED

The junction with which we are concerned is that between the germanium and the indium, at the actual surface of the germanium. This is, of course, much more clearly defined than the n-p junction in either a grown type or a diffused type of junction unit.

A typical set of characteristics is shown in Fig. 4. These are measured using the base current as parameter. It can easily be seen that for very small signal working the point Ic equals -0.06mA, Vc equals -0.5V and Ib equals -2uA is quite satisfactory.

Amplifiers giving a power gain of 18db at 30 Mc/s and using only a 3-volt supply have been made.



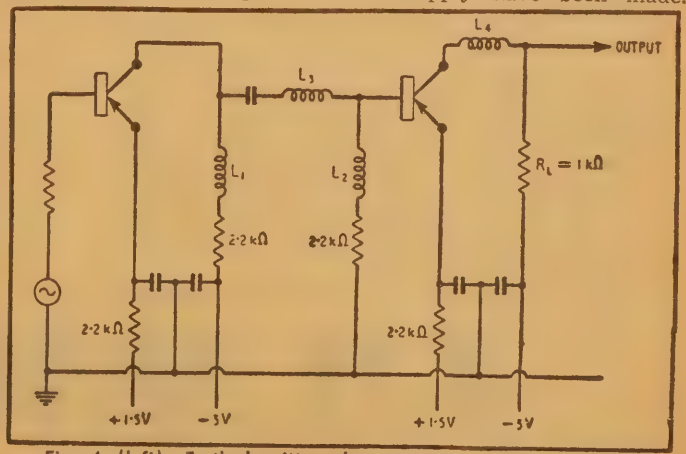
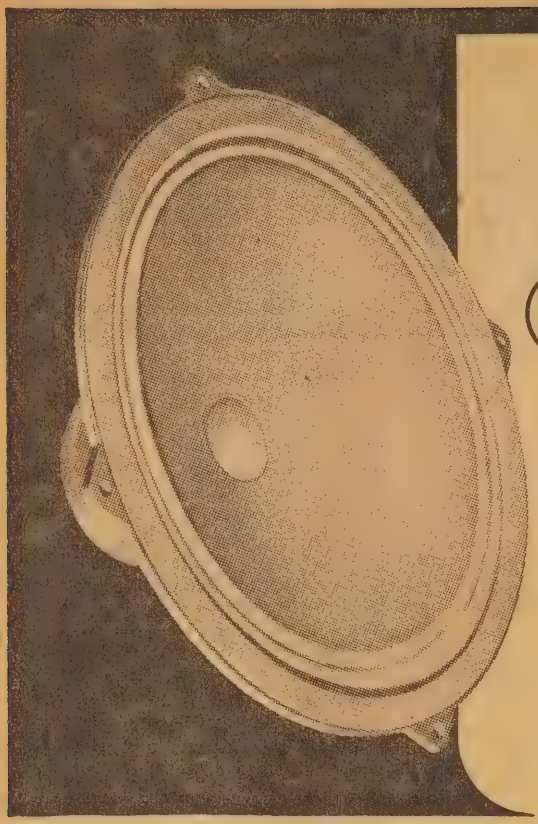


Fig. 4 (left). Earthed-emitter characteristic of the surface-barrier transistor and Fig. 5 (above). Circuit of video amplifier using surface-barrier transistors.



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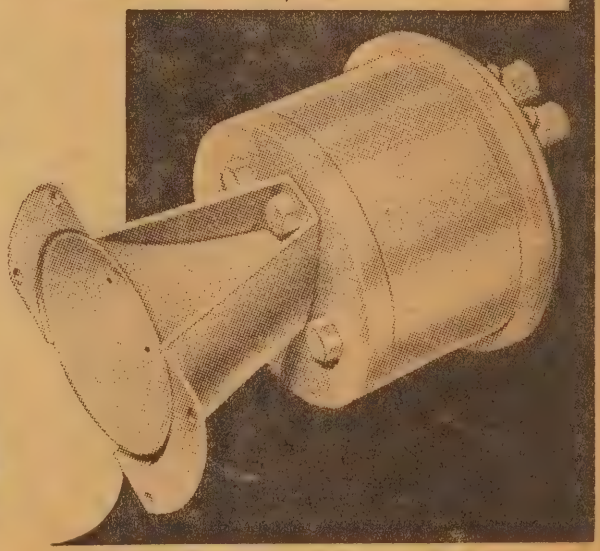

Right: Tweeter

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MOUNTAIN RANGE IMPROVES DISTANT VHF SIGNALS

Recent experiments with long-range VHF transmission in mountainous regions have demonstrated the possibility of utilising knife-edge obstacles as a means for increasing the received signal energy of television, FM, and military communications.

ANALYSES of the experimental data and interviews with scientists and engineers in the field were conducted jointly by the US Army Signal Corps, the national Bureau of Standards, and the Radio Corporation of America.

Indications are that the disadvantages previously attributed to the transmission of very high frequencies (30 to 100 Mc) among high mountain ridges can actually become powerful aids for reducing both transmission loss and tropospheric fading.

FUTURE SITES

The results of these obstacle-gain experiments may have a deciding influence on the future choice of sites for transmitting and booster station installations. For example, it may prove more advantageous to locate FM and TV stations at lower elevations a short distance out on the plains rather than on the foothills close to very high mountains.

Prior to the experimental verification of the obstacle-gain theory, which predicts the possibility of tremendous power gains for VHF propagation over mountain obstacles, long-range communication installations were located so as to be in radio line-of-sight of each other.

When possible, installations were made on the tops of mountains as a means of gaining a wider service range. However, the sites are often relatively inaccessible, making construction expensive. The obstacle-gain phenomenon appears to offer a solution to this problem.

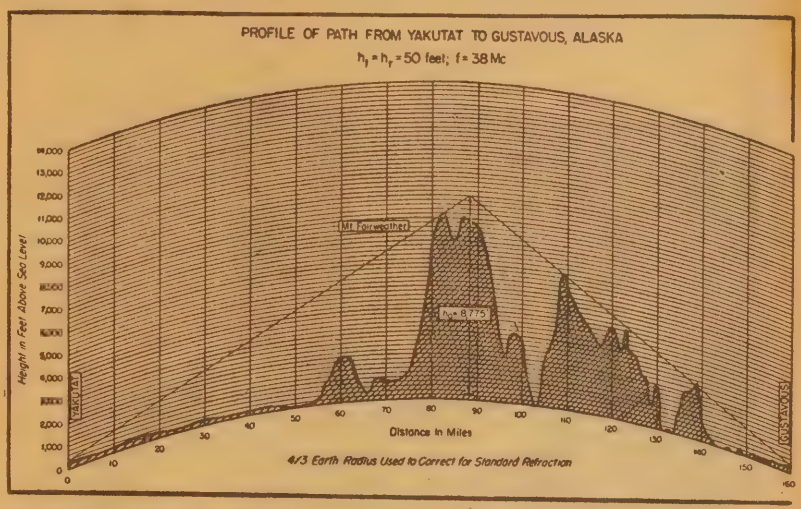
Preliminary studies of obstacle gain — which may be defined as the ratio of the received signal power with an obstacle in the path to the power received without it — showed that a considerable increase in received signal strength should result when a large knife-edge obstacle is located at the midpoint of the transmission path.

Japanese scientists have made similar theoretical and experimental investigations, and their installations were observed by the joint investigating team. The group also visited engineers and scientists conducting experiments in Hawaii and Alaska.

ORIGINAL WORK

The theory upon which obstacle-gain transmission is based was originally proposed by Schelleng, Burrows, and Ferrel (Proc. IRE 21, 427, March, 1933). Their hypotheses, which were partially substantiated by some experimental work, stated that the transmission of very high frequencies over a knife-edge type obstacle should be considered as a four-ray combination of reflection, diffraction, and atmospheric refraction.

Thus, if a transmitter and receiver are separated by a mountain, the radio waves would be received by means of the following mechanisms: (1) Diffraction at the top of the obstacle; (2) reflection from the ground between the transmitter and the obstacle and then diffraction over the obstacle; (3) diffraction over the obstacle and reflection from the ground between the obstacle and the receiver; and (4) a combination of the two ground reflections with diffraction over the obstacle.


PROFILE OF PATH FROM YAKUTAT TO GUSTAVOUS, ALASKA
$h_t = h_r = 50$ feet; f = 38 Mc
Height in Feet Above Sea Level
Mt Fairweather
h = 8775
Yakutat
Gustavous
Distance in Miles
4/3 Earth Radius Used to Correct for Standard Refraction

That high mountain ridges may be used to increase the received signal strength of VHF transmissions has been demonstrated by an obstacle-gain experiment which utilised the knife-edge of Mount Fairweather (Alaska) as the obstacle. This is a profile of the VHF transmission path.

The theory outlines methods by which the basic transmission loss over the path could be computed.

A requirement for the use of the obstacle-gain method for increasing signal strength is that the height of the obstruction must be greater than the elevation of the common horizon.

TYPICAL FIGURES

For example, transmission losses will be considerably reduced at 100 Mc if a knife-edge type of obstacle for a 150-mile circuit is at the midpoint of the path and about 1300 feet above the surrounding terrain. Theoretically, these conditions should result in a 30-db decrease in transmission loss over that which would be calculated if the obstacle were not there, with an accompanying increase in received signal strength (power gain of 1000).

The amount of reduction in transmission loss can be varied by different combinations of antenna heights, obstacle heights, and frequency.

One of the obstacle-gain experimental paths examined in detail was a 38 Mc, 160-mile communication circuit between Yakutat and Gustavous, Alaska, operated by the Civil Aeronautics Administration.

The radio-wave transmissions, which originated from and terminated at low-level installations (approximately 200 feet above sea level), passed over a 9000-foot ridge of Mount Fairweather. On the basis of the existing smooth-earth diffraction theory for an unobstructed path, the calculated transmission loss for the circuit is 207 db.

However, on the basis of the four-ray theory and the assumption that Mount Fairweather acts as a single 8775-foot knife edge, the expected transmision loss should be only 127 db. The experimental results showed the transmission loss was approximately 134 db, within 7 db of the value predicted by the knife-edge calculations.

The transmission losses (127 and 134 db) correspond to a calculated obstacle gain of 80 db and a measured gain of 73 db, respectively, greater than the field strength normally expected when considering radio transmission over a smooth spherical earth. These experimental results constitute additional proof that a mountain can behave effectively as a knife edge.

Radio waves transmitted over the theoretical smooth spherical earth are considered to arrive at points within the radio horizon by virue of a normal diffraction process and by scattering from the turbulent atmosphere.

LESS TURBULANCE

The turbulence, which is greater near the earth's surface and decreases with increasing height into the upper atmosphere, is also considered responsible for the relatively weak and fading signals normally observed at distances well beyond the horizon.

The obstacle gains associated with a properly situated knife-edge ridge have been found to be large enough to reduce the transmission loss accompanying the reception of these signals beyond the horizon,

(Continued on Page 111)

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NEWS AND VIEWS OF THE MONTH

Jet helicopter

THE first British "jet" helicopter has now flown—the Fairey Jet Gyrodyne, an experimental prototype which will be used to investigate this new method of lifting helicopters by jets of compressed air at the tips of the rotor blades.

The Jet Gyrodyne is in fact powered by an Alvis Leonides piston engine which supplies compressed air along the rotor blades to pressure jets at the tips, and also drives the two pusher propellers which are mounted at the end of short stub wings of the fuselage to drive the helicopter forward in level flight.

The tip jets and the pusher props work together so that the Jet Gyrodyne can take off and land vertically and also fly at relatively faster forward speeds than would be possible with a conventional helicopter which has overhead rotors only.

The Jet Gyrodyne itself will not go into production, but it paves the way for the bigger Fairey Rotodyne which is to be powered by two Napier Eland turboprop engines.

★ ★ ★

New gun

THE US has developed a jet aircraft cannon that fires shells faster than any gun ever used by the US Armed Forces according to the Defence Department.

Some American aircraft have been armed with "M-39" 20 mill. cannon since 1952, but it had been kept secret until now.

The "M-39" shells are fired by electricity instead of by the hammer or firing-pin of conventional machine guns.

Transistor hearing aid

DURING the month, we had an opportunity to examine first hand a couple of tiny hearing aids incorporating transistors.

One unit used valves in the initial stages but a transistor in the output stage, thereby affecting a considerable economy in battery drain.

The second unit used no valves at all, simply three transistors coupled by tiny interstage transformers. Including the battery, its overall dimensions were no larger than a cigarette case.

Despite the small size, the wiring was not crowded and technicians said that it would be easier to service than many comparable valve-type aids. It did not provide for automatic gain control, however, although there seemed to be no fundamental reason why this should not be achieved by appropriate additions to the circuit.

The present price of transistors will be reflected for the time being in higher initial cost but running costs of the units should be very much lower. This fact, together with the evolution of better batteries and small size, should prove a boon to those afflicted with bad hearing.

Also available locally are small stocks of crystal microphones especially designed for use in conjunction with transistors. They are characterised by very much higher capacitance than conventional types and are designed to give maximum current into a relatively low impedance load.

De-icing blanket

A KIND of "electric blanket" system has been developed by British experts to prevent icing on aircraft. The system consists of electrical heating circuits sandwiched between layers of synthetic rubber.

These rubber "blankets" are then tailored to fit around the sensitive parts of the aircraft, such as jet engine intakes, wing leading edges, cabin heater intakes, radio aerials, &c., where it is important that there should be no ice.

Dunlops, the designers, claim that these anti-icing blankets, which are attached directly to the metal surfaces of the aircraft and engines, will fit so closely that there will be no loss in aerodynamic efficiency.

The electrically - heated blankets run off the aircraft's normal electrical system.

★ ★ ★

Flying saucers

THE best brains in America are working on the "flying saucer" problem, according to General Nathan F. Twining, the United States Air Force Chief of Staff.

He said 90 pc of "flying-saucer" reports were pure imagination.

"But the air force could not explain the other reports.

General Twining said "some very reliable persons" had reported objects which could not be indentified.

He added, "We are not discounting all these reports."

So far no facts had been found to show there was "anything to" the reports, he said.

POPULAR SCIENCE QUIZ

Q.: Can a star grow in size?

A.: At a meeting of the Royal Astronomical Society in London, Dr. W. H. McCrea made an estimate that a star about five times the size of the sun would grow "appreciably" in about three million years when trapped in an interstellar cloud. Astronomically speaking, this is quite a short time.

When a star is trapped in an interstellar cloud, gravitational force causes the material to fall onto the star. Such a growth rate would furnish fresh hydrogen at least as fast as it is used up by the star.

The growth, or accretion theory was first proposed by Drs. Hoyle and Lyttleton of Cambridge, England to account for the young, massive stars, some of which are from 30 to more than 100 times the size of our sun.

Approximately one star in a million in our galaxy is of such a type. It would be about five million years old as compared to an estimated five billion years for the age of our sun. For a star with a mass about twice that of the sun, "appreciable accretion takes place" in about eight million years.

Q.: Do jet engine exhausts affect runway surfaces?

A.: According to reports in American aviation circles, the terrific heat from the blast of jet exhausts sometimes melts the surface of concrete runways made with Portland cement.

In an effort to find a material which would resist such temperatures, scientists of the Philadelphia Electric Co. developed a substance which is largely composed of the waste products recovered from the utility's large furnaces.

Tests of this inexpensive material by the Westinghouse Electric Corporation show that it can withstand temperatures up to 2400 degrees Fahrenheit. Composed of fly ash, lime and coal slag, a sample was tested for 15 seconds in a 2000 degree exhaust of a kerosene-oxygen rocket, the speed of the exhaust gases reaching several thousand feet a second. The sample melted to a depth of only 1/64th inch below its surface. No other detrimental effects were noted.

While ordinary aviation fuels usually do not harm concrete runways, slow-evaporating jet fuels seep into the concrete and attack it. The new material is not affected by spilled jet engine fuel.

Q.: What is "trypsin"?

A.: Trypsin, an enzyme, is a chemical naturally found in the human body. It has been used in aerosol form by Drs. Leon and Unger of Chicago in a new way of treating asthma and similar conditions to rid the nose and throat of thick, viscous discharges that are so troublesome.

Inhalations of aerosol trypsin produced excellent results in most of 73 patients with bronchiectasis, acute atelectasis, and bronchial asthma complicated with bronchitis or pneumonitis. Good results were also obtained in paroxysmal bronchial asthma. The treatment may also be important in management of patients who undergo tracheotomies, especially those with acute bulbar poliomyelitis.

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New engine

DETAILS have now been announced of the first "compound" aero-engine, the Napier Nomad, which is a combination of gas turbine and diesel piston-engine. Although designed to run on diesel fuel for maximum economy, the Nomad will operate equally well on kerosene or gasoline.

The engine has proved to have remarkable fuel economy in operating conditions where speed is not a primary consideration.

Unlike other types of engine, the compound engine is not highly sensitive to increases in temperature.

The Nomad is shortly to make its first flight in an experimental installation in a Shackelton coastal reconnaissance aircraft.

All three components of the Nomad —the diesel engine, the compressor and the turbine—are coupled together in a common mechanical system. The diesel piston unit is a two-stroke compression-ignition engine with 12 horizontally-opposed cylinders with sleeve valves. This unit provides a flow of gas to the main airscrew reduction gearbox. The turbine also drives the axial compressor which supercharges the piston engine.

★ ★ ★

Preserving food

THE US Army has announced a research project to find a safe way of preserving foods by atomic radiation.

If the research was successful, it would revolutionise food packaging and processing, the army said.

Atomic food preservation would increase the storage "life" of foods and lessen the need for refrigeration.

An army spokesman said: "The Army Quartermaster Corps will direct the research.

"The Atomic Energy Commission will help.

"The project primarily is for the benefit of the army, but private enterprise will be able to use any method we discover.

"The long-range objective is to learn whether atomic radiation can replace present food preservation methods.

"Any new method must preserve foods without destroying their odor, color, flavor, and texture."

★ ★ ★

New light on germs

A NEW "invisible light" technique can quickly identify germs resistant to some drugs, according to a recent report.

Doctors described the technique at a meeting of the Society of American Bacteriologists.

They said that if the technique became standard practice it would eliminate the use of some drugs in treating a patient.

Researchers at a New Jersey pharmaceutical company said they had noted detectable differences in the way different strains within given families of germs reacted to infra-red "invisible" light.

Strains resistant to some antibiotic drugs or to the new anti-tuberculosis drugs absorbed the light to a different degree than strains sensitive to the drugs.

The researchers said the technique offered a means of quickly showing that a germ had some resistance or susceptibility to a given drug.

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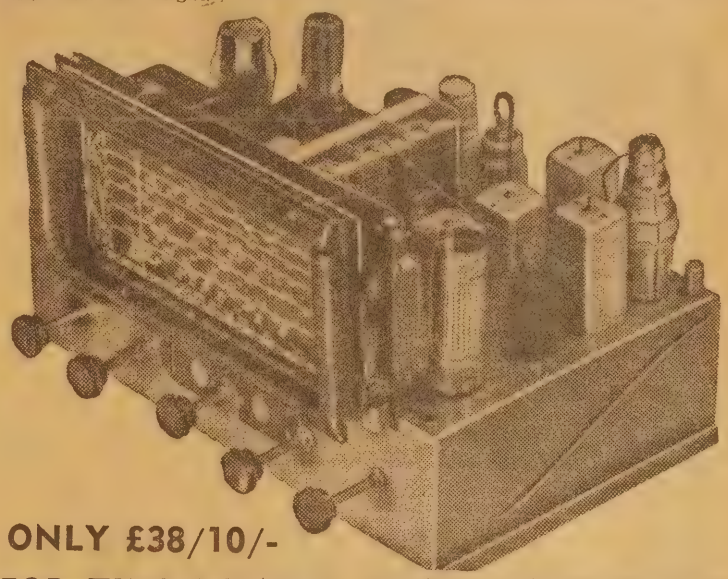

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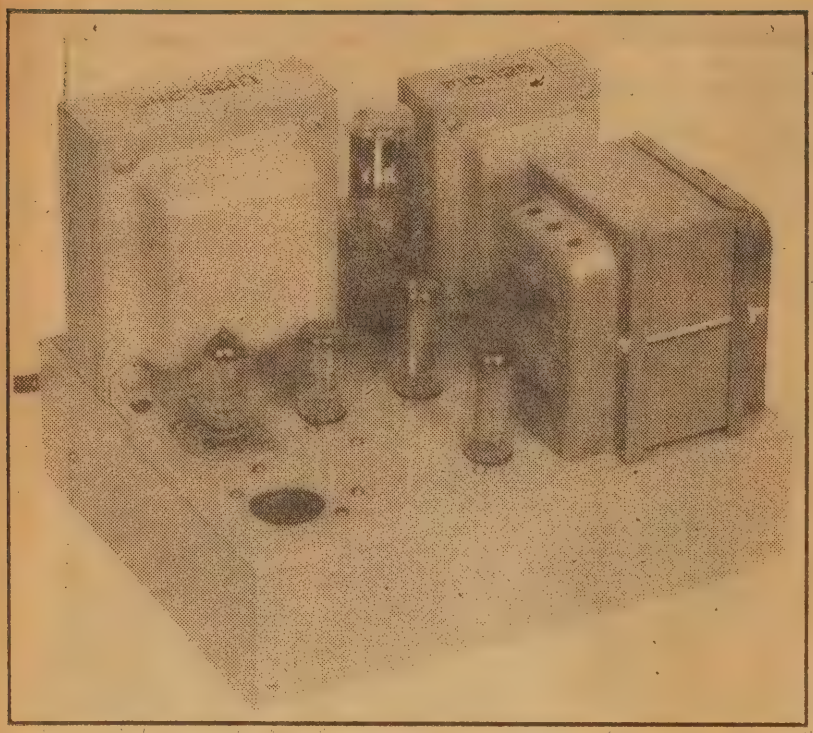


The lead from the control unit plugs into the 6-pin socket in the foreground. Behind it is the 6AU6 preamplifier, next to it the phase changer, and then the 6BW6 output valves. Valve cans could be used and shock mounting isn't essential. The output transformer should be rotated on its axis until any hum induced from the power transformer is eliminated. If present, this hum will be heard with all valves removed.

THE PLAYMASTER SEVEN

This new version of our standard 10-watt amplifier is intended for use with the new Control Unit Four described in this issue. Together they will give you a really high grade record player, easy to build and inexpensive to buy.

THE Playmaster No. 2 amplifier is without doubt the most popular piece of equipment of its kind we have ever published. Readers started to build it from the moment the issue describing it hit the streets, and they are still building it. The reason for this isn't hard to seek. As with all our designs which "go over" well, it sold because it hit the right spot at the right time.

THE PLAYMASTERS

The idea behind the Playmasters, as set out in the first article introducing them, was to re-state the entire amplifier position in the simplest and most practical terms consistent with a high order of performance. We were at the commencement of a new era in the record business with the rise of the microgroove record, and everyone knows now how profound its influence has been on our equipment, our listening, and the music we have been able to hear. We felt that from a welter of new ideas about amplifiers, and the pitfalls that went with many of them, our readers were looking for a lead. The Playmasters gave it to them.

It should be made clear at this point that we have a healthy respect for the engineering behind some famous amplifier names which for obvious reasons we won't mention specifically.

But it cannot be denied that such equipment is very costly, and is designed to a standard far beyond that really necessary for high quality record playing in the home. There are many avenues open to a manufacturer of amplifiers other than this field, and with the special facilities and a world market at his command, he would be foolish if he did not build into his equipment the finest possible performance so that even the most demanding specification can be met, no matter what use the purchaser may have for his gear.

It is in such a field that hairs are split over fractional percentages of distortion and so on which, however important they may be for some purposes, are far beyond detection when we place a pick-up on a record and play it back through even the best of speakers currently available to the public.

PRACTICAL APPROACH

We have been too long at this game not to feel the lure of always trying to build something better, even if the difference is only to be told by instrument checks. Every time we find a way to better our results in any particular, we learn something new, and get a better background to the reproduction of sound as a whole.

But when it comes to guiding our readers, who haven't any special facilities for such work, but who do want something good which they can make and operate without more than average knowledge, we must take stock of how far it is reasonable to go in cost or complexity.

The Playmaster amplifiers, therefore, were never intended to be clever, or complex, or laboratory world beaters. They were intended for you, our readers, to build, with our undertaking that they will work as well as ours did if you build them up the same way. We checked them very carefully to see that there were no hidden tricks which we could detect which would involve you in obscure faults or electronic vices. We not only tested them on the bench, but played them to ourselves and our friends, compared them with the best equipment we could find, and tried to include in them an extra margin of docility to take care of the fact that you mightn't be as adept as we are at putting them together.

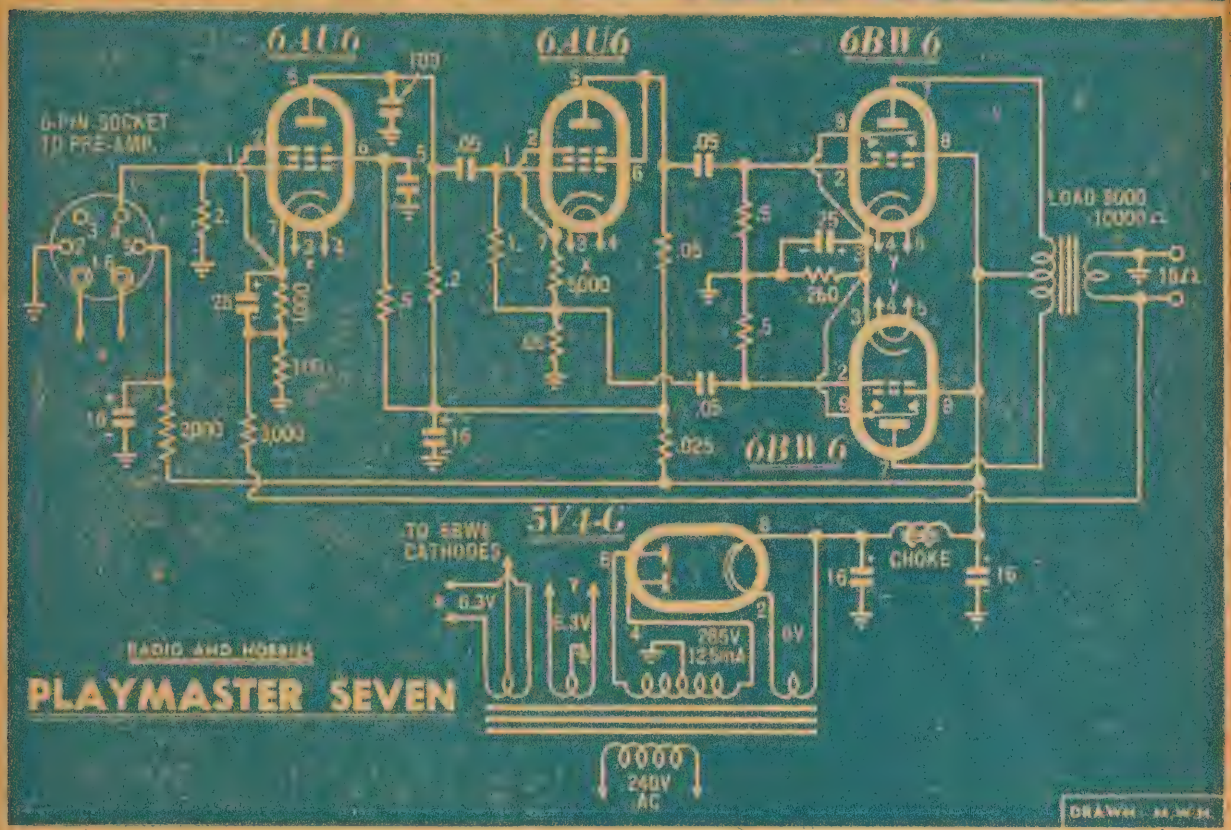
The fact that the amplifier circuits at least have been fairly straightforward has been the subject of comment by some readers who seem to think that orthodoxy can't be sometimes better than unusual phase-changer circuits or complicated feedback paths. We can think up as many of these as the next man, and often do for your entertainment and pleasure. It is true, also, that there are several standard approaches which we could have used to give comparable results.

REVISED No. 2

But each amplifier can use only one circuit, and it should be remembered therefore that those we have used are only our answers to a common problem. We can assure you, however, that in our opinion no comparable alternative will give you any better results.

The Playmaster Seven is really a revised version of the Playmaster No. 2, its new name being an attempt

CIRCUIT DIAGRAM OF NEW PLAYMASTER SEVEN



The circuit is similar to No. 2 but uses smaller valves. The 260 ohm bias resistor may call for two values in series. Up to 275 ohms could be used with little effect on performance and lowered plate dissipation if a more convenient value. Socket connections are the same as for other Playmaster units.

to avoid confusion with the old when ordering parts and so on. Because it is more than two years since No. 2 appeared we will treat the Seven in this article as a new circuit for the benefit of those who haven't a copy of the original article.

The basic requirements of the amplifier are a clean output of about 10 watts, an input sensitivity of about 350 millivolts, low distortion, particularly at operating levels, flat frequency response over a wide range, low hum level, low output impedance, simple construction from standard parts, and reasonable cost.

An output of 10 watts is a very good figure for general use and isn't much as it sounds, even remembering that with a sensitive speaker the average power used will be far below that figure. Its main value is in accommodating sudden peaks in output which can run many times higher than average, and in ensuring that distortion will be low at operating levels.

DISTORTION

Related to power output, distortion rises pretty much in direct proportion until nearly maximum is reached, at which point it takes a sudden jump. The ratings we have used for the output valves give a distortion rating of only 2 pc at full output which, of course, is reduced by feedback to about one-seventh of this figure. If our average listening level is one watt, and that is quite high, we can expect a further reduction of about 10 times. The maximum power rating therefore assists materially in keeping the likely distortion to a fraction of 1 pc at normal volume level.

It so happens that this 10 watts comes naturally with the lowest power we can expect with a push-pull circuit, virtually a necessity with a really good amplifier. Any of the standard output valves will approximate this figure, but we have chosen the 6BW6 because it seems to be the most robust of those offering.

It has the same ratings as the 6V6 so that we can push up the plate and screen voltage to 285 volts (and a bit higher won't matter in practice). With a load resistance of 8000 ohms we can get about 12 watts from this combination, but because the highest grade output transformers might be obtainable only in 10,000 ohms as the nearest, we sacrifice maybe a couple of watts through the slight mismatch which is otherwise not important.

The 6AQ5 could be used with a plate voltage of 250 between plate and cathode without circuit alterations and without serious drop in power output. It uses the button 9-pin base and would be a proposition if you have two on hand.

The valves should be matched as

PARTS LIST

- 1 chassis 9½in x 8in x 2½in.
- 1 power transformer, 285V per side, 125mA., 6.3V C.T. 3A. 6.3V 2A. 5V 2A.
- 1 125 mA filter choke.
- 1 output transformer 10,000 ohm P-P to 15 ohms (or to speaker voice coil impedance).
- 1 miniature 4-pin plug and socket for speaker. 1 6-pin socket and plug and 2 miniature 7-pin sockets. 1 octal socket. 2 miniature 9-pin sockets.

VALVES

2 6AU6's. 2 6BW6's. 1 5V4G.

CAPACITORS

1 100 pf, 3 .05 mfd 400VW, 1 .5 mfd 350 VW, 4 16 mfd 525PV electros., 2 25 mfd 40PV electros.

RESISTORS

1 100 ohm, 1 260 ohm 3W, 1 1000 ohm, 1 2000 ohm, 1 3000 ohm, 1 5000 ohm, 1 .025 meg., 1 .2 meg., 3 .5 meg., 1 1 meg., 1 2 meg.

SUNDRIES

4 8-tag mounting strips, grommets, power flex and plug, hookup wire, nuts, bolts, solder lugs etc.

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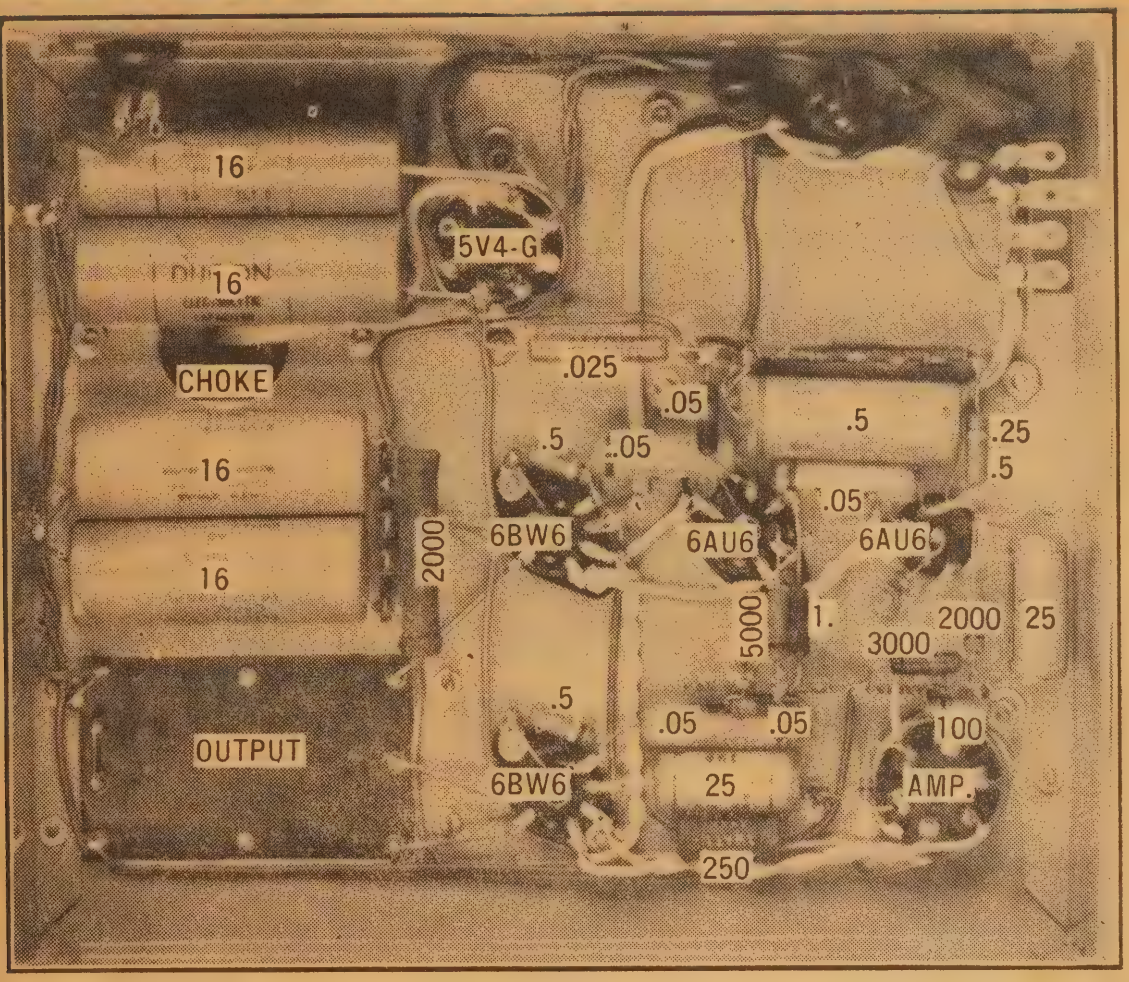

This picture shows where we mounted all components. Later the output transformer was rotated about 30 degrees from its present position to remove slight hum pickup. Check for this before mounting it. The phase changer socket shown is a noval, but layout isn't materially altered for the 6AU6 as specified, and which uses a 7-pin socket.

nearly as possible for best results. They should show only a few per cent difference in ca hode current or mutual conductance on a tester, although as a rule new valves are likely to be reasonably well balanced.

The input sensitivity of 350 millivolts is related to the output of the Control Unit Four intended for use with it, and is obtained naturally with standard valves and about 17 db of feedback. It means that the amplifier is not too hard to drive, and not particularly sensitive to hum pick-up or instability which is always a risk when feedback is greater than about 20 db.

We have already mentioned the matter of distortion and the fact that it is very low, partly due to the use of negative feedback. This is obtained by feeding some of the voltage developed across the voice coil circuit into the cathode circuit of the first amplifier valve in such a manner as to reduce the overall gain by about seven times, corresponding to about 17 db of feedback. The reduction of distortion is in direct proportion to the reduction in gain.

The reduced distortion is effective on all circuits which are inside the feedback loops and this, of course, includes the output transformer. Because a high quality component is specified in the first instance, the net result is a particularly "flat" output free from any peaks or hollows in the response.

FEEDBACK

The effect of feedback on reducing distortion is quite automatic, for the amount of feedback is proportional to the gain of the amplifier at any frequency. At the extreme top and bottom frequencies, where, for various reasons, the gain of the amplifier will drop, the amount of feedback will drop in proportion, and the net reduction in gain will be a lesser percentage of that without feedback. It can in fact be considered as an automatic control which operates to keep the overall amplification constant at all frequencies.

As the output transformer by its nature is the most difficult component to design with a wide, flat response, it is obviously a good thing to allow the feedback to compensate for its deficiencies even when a very good type is used.

Tests with this amplifier indicates how successful is the entire combination, as a check with the beat frequency oscillator shows virtually no variation between 20 and 30,000 cycles, a slight rise of about 1.5 db up to 50,000 cycles, and a return to reference at 70,000 cycles. After that, as might be imagined, the response drops off fairly rapidly.

This response curve means extremely low distortion, very good transient response, and freedom from oscillation, as the waveforms at all times were quite sharp and clean. Tested on a square wave input at 1000 cycles, the pattern showed no noticeable distortion at all.

Power handling capacity was substantially uniform over the audible range through which full output of 10 watts was realised into a resistive load. Only at the extreme top and bottom of the range was the output less than this. At 20 cycles a clean sine wave was obtained at between nine and 10 watts, which speaks well for the output transformer.

Lesser quality transformers may be expected to show a somewhat less

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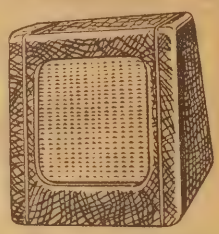

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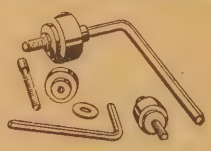

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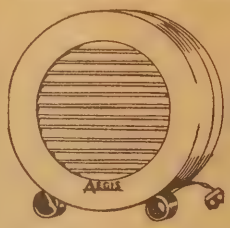

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favorable response, with a drop in power output somewhat earlier than the one we used. A greater variation in response at the supersonic frequencies may also be expected, and even oscillation if the transformer isn't so good. The bypass on the 6AU6 plate helps to stop this but the best course is to use only the best type you can get. Ours was of the same design as originally produced for the Williamson amplifier.

RESPONSE

Used with Control Unit Four, the hum level is negligible, and cannot be heard more than a foot from the loudspeaker at any setting of the gain control, and with the input of the unit earthed to prevent hum induction into the pick-up head.

The high degree of feedback also provides very high damping on the loudspeaker cone which smooths out the bass response. Tested with a speaker having a rather pronounced natural resonance, the damping was such as to make it impossible to pick any rise at resonance even with no baffling on the speaker.

This order of performance can be accepted as quite equal to, and better than, the best radio playback requirements, and listening tests with wide range input and output confirms this.

The amplifier is very easy to build, and has nothing critical about it. It is smaller and more convenient than the No. 2 although the circuits are identical. The smaller chassis requires a different layout, and we have included a labelled underchassis picture to show you how we put it together.

Once again we have employed the new miniature type of components, and instead of using a single panel mounting strip, have wired most of the parts directly between valve socket pins or on simple tag mounting strips. The filter condensers are mounted well out of the way of the sockets to give more room, and the sockets themselves oriented to bring the pins in the most convenient positions relative to each other.

VALVE TYPES

Two 6AU6's are used in the first two sockets, one as a pentode amplifier and the other as a triode-connected phase-changer. In practice almost any triode can be used as a phase-changer, and when the photographs were taken we were using one half of a 12AU7. The 6AU6 is a cheaper valve and quite as satisfactory. There is no need to shield these valves, although a note on this point appears later on in the article.

The filament supply to the valves must have a centre-tap, or if the winding is not tapped, a 50 ohm CT resistor must be wired across the winding. The tap, real or artificial, is connected to the cathode of the output valves to supply a positive bias of about 20 volts to the filaments. This is a simple precaution against hum in the Control Unit through emission from the heater wires. The output valves can be supplied from a second 6.3 volt winding if the total drain of the whole set-up is too much for one filament winding. But the centre-tapped winding must supply all the other valves, and be earthed at no point other than the output valve cathodes.

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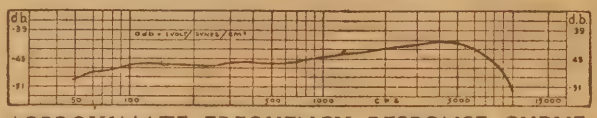

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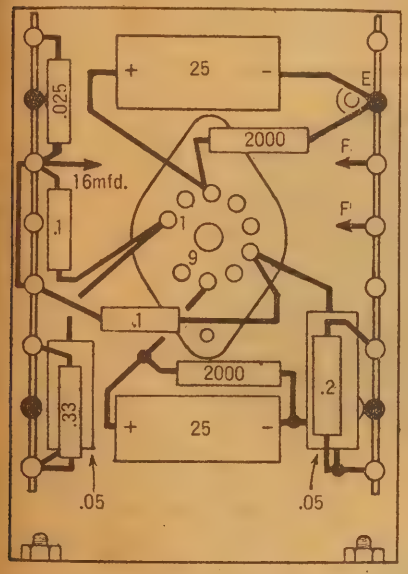
supply, high tension, and earth return wire, and input to the Control Unit, using the standard order of connection shown in the diagram. The grid connection should never be made to a pin adjacent to one of the heater wires.

CONNECTIONS

The short lead from the first 6AU6 grid to the 6-pin socket should be made with shielded wire, even though it is so short. The feedback lead from the voice coil must of necessity come near this lead, and any interaction with the grid, being positive in nature, may cause oscillation at a very high frequency. Keep these circuits away from each other. The 2 meg. resistor should be wired straight across the 6-pin socket with the shorest possible leads.

The 2000 ohm resistor which feeds the high tension to the unit is designed to take also the drain of a radio tuner. Without a tuner it can be increased to about 10,000 ohms with improved filtering for the unit, although this is a minor point.

The filter condensers other than that across the rectifier filament can be increased in value if desired for better filtering, although the improvement is likely to be small because the filtering is already so good. Such condensers may be of the 350 volt peak rating, but the first 16 mfd



This diagram shows how we mounted the components on the valve socket bracket. Complete wiring is not included and drawing is not strictly to scale.

type should for safety sake be 525 and better still 600 volt peak rating.

The feedback resistor shown is for 15 ohm speakers and will be too high for 8 ohm or 3 ohm types, which should use 2000 and 1000 ohms respectively. The exact value would be that which reduced the amplifier gain by about seven times at 1000 cycles for 17 db feedback.

As a precaution against parasitic oscillation, suppressor resistors of 1000 ohms grid and 100 ohms screen are sometimes advised, wired right at the respective socket pins. At no time, however, did we observe any such tendency to oscillate, and we mention the point purely to complete the picture.

With a transformer of 120 mills,

(Continued on Page 105)

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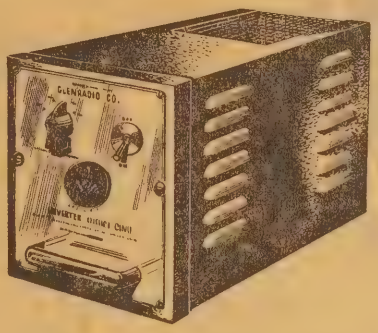

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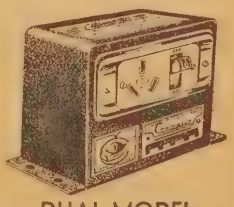

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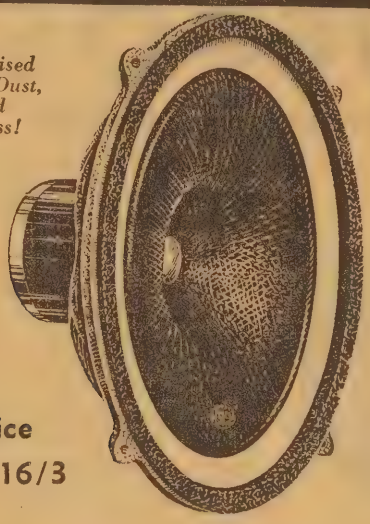

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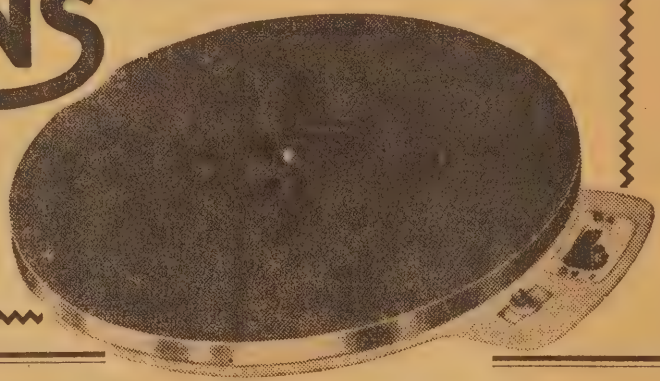

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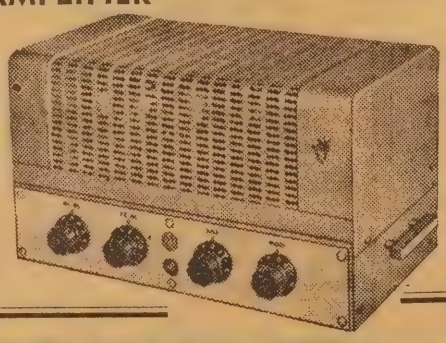

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FROM THE SERVICEMAN WHO TELLS

This month I have a couple of car radio cases, one from a correspondent and one from my own bench, plus a rather mysterious fault in a mantel set. The first car radio case raises the interesting matter of car electrical systems and their adjustment, while the mystery case I must leave to the reader to solve.

FROM a country correspondent, Mr. J. D. G., of Cootamundra, I have a rather interesting letter concerning car radios in general and one in particular. The following extract from his letter tells the story of the particular case.

A while back a fellow about 50 miles out came in with a car radio under his wing.

"Well what's the problem?" I queried.

"It's a tough one," he answered. "The set performs OK when the car is standing still but when I leave home and run about 14 miles the set stops and a funny smell comes up. I switch it off and come on to town without it. Then for a few miles on the way home I have music again. After that there's nothing."

This job once would have given me a severe headache (the first few did). Putting the machine on the bench and playing it on 12V, it will go forever and never give trouble.

But I seized the set and removed the covers and there I saw what I wanted to see, a dark brown screen-feed resistor, a sure sign of overload. Well I hooked it up (I keep a standard aerial mounted on the bench as part of the set up) and on 12V nothing happened. 14V ditto, but a short burst of 18V and tap on the 6BA6 and, bingo, another problem solved.

The trouble was caused by a faulty 6BA6, or two of them if you like, overloaded by a treacherous voltage regulater. It needed only a run to top up the battery (the juice began to rise after about 14 miles) and the stage was set. The valves shorted inside (nearly always the screen, hence the smell and overloaded screen resistor) and the set stopped.

Had he turned his headlights on, the set may have commenced playing again, as they would bring down the voltage with the extra drain.

Well, the set worked OK after that, so we tripped out to the car and lifted the bonnet and there was the battery, leads nearly dropping off (adding to voltage rise), and acid still dropping off the underside of the bonnet, where the battery had shot it like a volcano.

I murmured, "Appears the regulator needs checking."

"Well," was the reply, "the mechanic at the garage did it; he put in a screw driver, turned a doover and, lo and behold, I always have a fully charged battery."

Mr. J.D.G. goes on to make some caustic comments about garage mechanics who tamper with voltage regulator systems, and expresses the opinion that very few of them are equipped with either the knowledge or the equipment to do the job properly. As a result, their efforts frequently cause serious damage to the car's electrical equipment.

EXCESSIVE VOLTAGE

This case is a very interesting one and raises one or two points which are worthy of comment. There is no doubt that our friend rightly diagnosed the fault as being due to excessive voltage in the car's electrical system and, consequently, was able to repair the set and advise the owner as to what steps should be taken to prevent a recurrence of the trouble.

From the owner's point of view, therefore, all was well, and this was the most important thing.

However, on a purely academic basis, there is one point I am prepared to query: Did the overload voltage cause the valves to short internally as J.D.G. suggests, or did the set fail for some less obvious reason?

I am quite prepared to accept that there may have been a shorted screen in the particular case mentioned, but I suggest that the valve concerned had a predisposition to this fault, anyway, and that the abuse merely hastened the effect. In the other cases which our friend mentions (and apparently he has encountered quite a number) it seems reasonable to suggest that the effect was of a more predictable nature.

My suggestion is that the heat generated by the overloaded filament (it would be dissipating something like twice the wattage if the voltage rose to 18) provided an ideal set of conditions for grid emission, particularly when it is remembered that most car radios are not nearly as well ventilated as a normal radio.

I dealt with the subject of grid emission a few months back (March, '54 to be exact), so there is no point in dealing with it in detail again. Briefly the story is as follows: The grid, due to its proximity to the cathode, becomes hot enough to emit a few electrons, and, having thus lost some negative charge, becomes slightly positive, relative to the cathode.

(Being in a country area, too, the signals would be relatively weak and not able to develop a high negative AVC voltage.)

RESISTOR VALUE

The value of the positive voltage developed for a given grid current (number of electrons emitted) will depend on the total value of resistance in the grid circuit. The higher the resistance the greater will be the voltage developed across it.

Providing the heater is operated within normal ratings, and the grid resistance is not allowed to exceed the values stated by the manufacturer, everything runs along smoothly and the slight tendency to positive generation on the part of the grid is adequately controlled by the remainder of the circuit.

But double the wattage dissipation of the cathode and house the equipment in a poorly ventilated metal box and something pretty drastic is bound to happen.

In this case I suggest that the grid rapidly became sufficiently less negative to increase substantially the plate and screen current of the valve, thus aggravating the heating effect, and rapidly bringing about a condition where the particular stage was completely choked up, causing the set to fail.

VOLTAGE REGULATORS

At the same time the excessive screen current could easily overload the screen dropping resistors, thus helping to indicate the stage involved, and also, perhaps, giving rise to the theory about an internal short.

The other point concerns the automatic voltage regulators, which are normally fitted to all modern cars. If operating correctly, they provide as nearly ideal charging conditions for the battery as one could wish. However, as my correspondent points out, a lot of trouble can be caused when these devices are tampered with by mechanics who have neither the training nor the equipment to do the job properly.

The result is a severe overload, not only of the radio, but also of the lights and any other components which may be used for long periods, to say nothing of the battery and generator.

PROTECTION

These two latter components are most important because they form a vital part of the car's power plant and are relatively expensive to replace. It was for the express purpose of protecting them that the present regulator systems were evolved. However, they can be rendered virtually useless by an over-zealous mechanic with a screwdriver.

It is hardly within the province of a radio serviceman to undertake adjustment of these devices, and, in fact, it might be unwise in most cases to become entangled with this side of the system. At the same time he should at least know what the things are supposed to do and what would be a reasonable top voltage to expect under the most severe conditions.

The ideal method of charging a battery is to charge at a relatively

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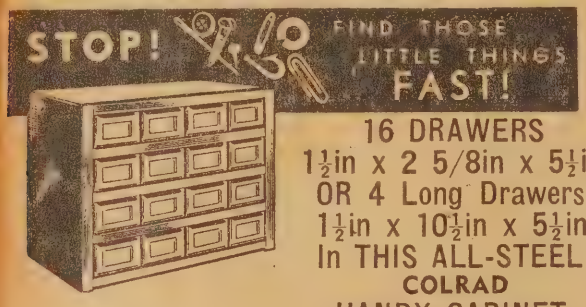

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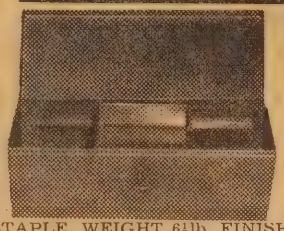

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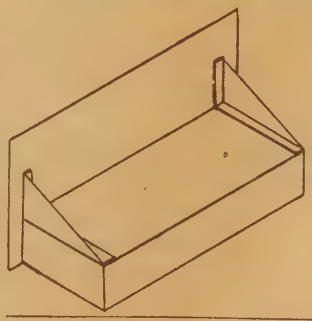

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high rate while the battery is discharged, and when most of the energy can be usefully used to produce chemical reaction; then to decrease the rate as charge progresses, until eventually, when the battery is fully charged, the rate is reduced almost to zero.

The present systems aim to do just this and, in practice, they are very effective. In a properly adjusted 6-volt system the battery may charge at rates up to as high as 40 amps for short periods when the battery is low, but will drop to only one or two amps after several hours driving on a long trip.

In a 12-volt system the top charging rate would be in the region of 20 amps with proportionately lower values at various degrees of charge.

Because the charge is tapered there should never be any sign of violent gassing of the battery at any stage. If there is such evidence, as in the case quoted above, it is a sure indication that the battery is being overcharged, and other components overloaded.

Although commonly referred to as voltage regulators they are more correctly termed voltage-current regulators, since they are designed to respond to both characteristics.

The current regulator is intended to operate when the battery is in a discharged state, and unable to produce sufficient back EMF to limit the charge current to a safe value for the generator. Under these conditions the system should be so adjusted that it allows the battery to charge at the maximum rate, which the generator will stand (in order to charge it as quickly as possible) but no more.

As the battery commences to charge, the voltage across it rises and the current will drop automatically. When it is capable of holding the current to a safe value of its own accord the current regulator ceases to function and the battery continues to charge normally until it approaches the fully charged condition.

RISING VOLTAGE

At this point the voltage, which has remained essentially constant over the greater portion of the charge, commences to rise and this is a sign for the voltage regulator portion to come into operation and restrict the charge rate still further to avoid overcharging the battery.

At this point it would be reasonable to expect a voltage in the order of 2.5 volts per cell, or approximately 7.5 volts for a nominal 6-volt battery and 15 volts for a nominal 12 volt.

While at first glance even these figures may appear excessive, they are not unreasonable, and must be expected where simultaneous use and charging of the battery is contemplated.

The components intended for use in such systems are normally designed on this basis and the radio should likewise be able to operate under these conditions, not forgetting that there is always some voltage loss in the connecting leads.

However, voltages in excess of these figures should not be necessary and indicate that all is not well with the system.

It should also be pointed out that it is only in exceptional circumstances that these systems should need adjustment since they normally leave the factory correctly adjusted and, by their very nature, should be capable of coping with whatever discharge conditions the system is likely to encounter.

SUITABLE BATTERY

If a battery consistently fails to do its job in such a system, it is a fairly safe bet that the demands made upon it are quite unreasonable or that the battery has "had it". In either case it is obvious that the cure is not to be found in brute force tactics, but rather in the use of a battery which is capable of doing the job.

A crumbled tuning slug caused trouble with this transformer.

From my own workshop I also have a story of a car radio. Initially the set was brought to me with the relatively simple trouble of a defective coupling between the flexible tuning cable and the set proper. This did not present any great difficulty, but the owner had intimated that a general overhaul might be worthwhile, so I proceeded to give it "the works".

The first fairly obvious point was a low HT, being in the order of 150 volts. A valve check revealed that the rectifier was weak (it used a non-synchronous vibrator), but all others in good order.

Replacing the rectifier helped the HT somewhat, though it was still less than 200 volts and inclined to waver slightly, a symptom which is generally an indication of a faulty vibrator. This suspicion was confirmed by replacing it with a new one, which increased the HT to about 230 volts, the normal figure for this set.

The increased HT voltage improved the sentivity considerably, mainly due to the restoration of normal screen voltages, and a tune up with the generator supplied the finishing touches. However, while handling the dial I realised that this was by no means as easy to read as it should be, mainly because the celluloid cover had turned yellow and opaque with age.

POOR POINTER

A new cover from the makers improved things considerably, though it still seemed to me that the pointer was not as easy to see as was desirable. After all, tuning a set while driving a car is not the easiest thing in the world, even with an easy-to-read dial. With a poor one it can be almost impossible.

In this case it seemed that the pointer was inadequate, being made from a short length of tinned copper wire painted black. At first I toyed with the idea of replacing it with a heavier gauge, but baulked at the idea when I realised that I would have to pull the whole dial unit to pieces to do so.

Then a piece of light gauge black plastic tubing on the bench caught my eye and I realised that here was a simple solution. It was a comparatively easy job to slide this over the wire pointer and it increased the diameter and improved the visibility appreciably. It also covered a few scratches on the old pointer and is not likely to deteriorate itself, so that the idea seemed to score on all points.

I tuned over the band a couple of times as a final check and was just congratulating myself on a job well done when I happened to turn the set right side up preparatory to putting it on the "jobs completed" shelf. There was a crackle and splutter and then silence. Well, I suppose it could have been worse. It could have happened after the customer had taken delivery.

INTERMITTENT SHORT

I turned the set over again and the fault vanished but returned again when I turned it back again. This time, however, it was in a slightly less violent form, producing crackles and noise but not actually stopping the set.

I soon established that there was an intermittent short somewhere in the HT line but, probe as I might, I couldn't find where. The task became all the more difficult when the fault (as so often happens with intermittents) decided to give it away for the day and stubbornly refused to re-appear.

This being so, there was nothing I could do except leave the set running on the bench while I proceeded with another job, prodding or shaking the offending chassis at regular intervals to see if it had changed its mind.

Eventually my patience was rewarded. The crackles suddenly reappeared as I turned the chassis through what seemed to be a rather critical angle. Propping it on the bench in this position I commenced a gentle tapping procedure on various parts of the chassis in an effort to find out which part was most sensitive.

IFT SUSPECT

The whole thing was so sensitive that it was difficult to be very definite but it did appear to be worst in the region of the second IF transformer. Having had my attention concentrated on this part of the set I noticed the faint reflection of a spark inside the IF can every time the set crackled. Well, it was quite a relief to at least know where the trouble was.

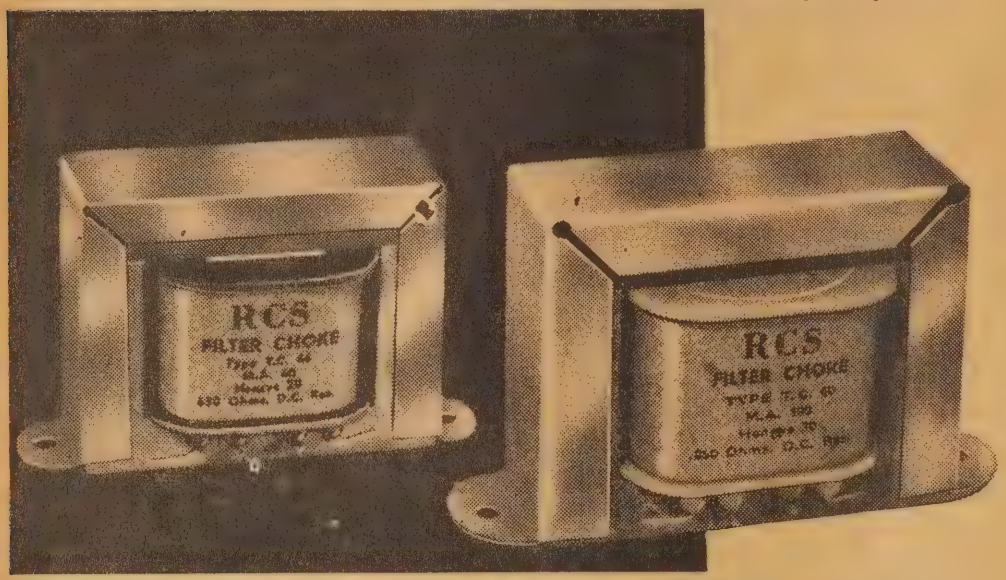
The next thing was to find out why. I removed the IF and carefully slipped the works out of the can. As I did so a small particle of black material dropped on to the bench. Closer examination showed it to be a fragment of "iron dust" core material and inspection of the transformer soon revealed the full story.

For some reason the bottom core had become jammed in the winding and adjustment of the brass screw during the alignment procedure and had weakened or broken the junction between the two. As a result a piece of core material had broken away from the core and was floating around inside the can, causing a HT short every time it came between the HT lug and the can.

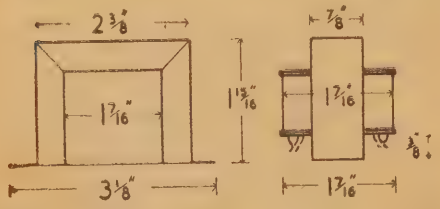
The position was further aggra-

R.C.S. release details of . . . CHOKES . . . TRANSFORMERS

Here are full details of types available in R.C.S. filter chokes, audio chokes and transformers, filament and auto transformers, speaker transformers and speaker replacement windings. It is suggested that these details be kept for reference. These R.C.S. components are both designed and manufactured in the light of latest findings in the field of electronics. Brackets are of aluminium and bobbins are of moulded polystyrene.



FILTER CHOKES AND SPEAKER TRANSFORMERS
Size: Core Section ⅜in x ⅜in 10 watts
o/all sizes 2¼in L x 2in H x 1¼in W



FILTER CHOKES	Retail Price
TC 66 14/60	10/6
TC 66 Windings only.	6/6

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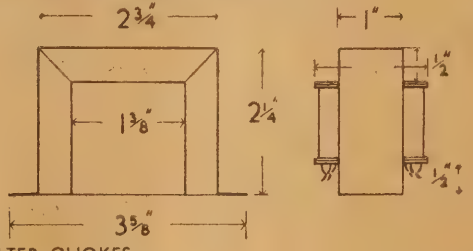
Type	Primary Ohm	Voice Coil Ohm	
TS 23 Single Triode	3500	2.3	16/-
TS 24 Single Triode	3500	3.9	16/-
TS 25 P/P Triode	3500	2.3	16/-
TS 26 P/P Triode	3500	3.9	16/-
TS 27 Single Pentode	5000	2.3	16/-
TS 28 Single Pentode	5000	3.9	16/-
TS 29 P/P Pentode	5000	2.3	16/-
TS 30 P/P Pentode	5000	3.9	16/-

SPEAKER REPLACEMENT WINDINGS

F 132 Single Triode	3500	2.3	7/-
F 133 Single Triode	3500	3.9	7/-
F 134 P/P Triode	3500	2.3	7/-
F 135 P/P Triode	3500	3.9	7/-
F 136 Single Pentode	5000	2.3	7/-
F 137 Single Pentode	5000	3.9	7/-
F 138 P/P Pentode	5000	2.3	7/-
F 139 P/P Pentode	5000	3.9	7/-

CHOKES AND TRANSFORMERS
Size: Core Section 7/8in x 7/8in 15 watts
o/all sizes 2¾in L x 2in H x 1⅜in W



FILTER CHOKES	Retail Price
TC 60 100 M/A 30 H	17/8
TC 70 75 M/A 50 H	18/-
TC 65 50 M/A 30 H	16/4
TC 58 L/T 3 amp 50 M/H Vib.	17/6

AUDIO TRANSFORMERS

TB 42 A Class 3 to 1	27/-
TB 43 A Class p/p 3 to 1	28/-
TB 44 B Class p/p 1½ to 1	27/-

AUDIO CHOKES

TA 4 100 H 1000 ohms	21/-

FILAMENT AND AUTO TRANSFORMERS

TP 53 2.5 v 5 amp	23/-
TP 54 4.0 v 3 amp	23/-
TP 55 6.3 v 3 amp 15 watt	20/6
TP 80 6.3 v 4 v and 2.5 auto	18/-
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TP 57 18.0 v 1.0 amp	23/-
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R.C.S. RADIO PTY LTD. 651 FOREST RD., BEXLEY, N.S.W.

vated by the design of the unit, the connections to the various windings being in the form of copper strips which ran the full length of the assembly and were only a fraction of an inch from the inside wall of the can.

In the normal way this could cause no bother because there was adequate protection against the conductors actually touching the can, but a piece of conducting material floating around inside the can was another matter.

A NEW IFT

At this stage it was obvious that a new IF was needed, the junction of the core to the brass thread being so weak that a few more turns wrecked it completely. Since it was a special type the correct replacement had to be obtained from the makers, then fitted and the entire alignment checked again.

After a prolonged run on the bench and a moderate amount of pounding there was no evidence of any other similar defects and I fitted the set back in the owner's car.

And now for the mystery of the month (or the year for that matter, because I can't recall anything quite like it before).

The set was a fairly standard five valve mantel set employing a 6B6 as combined detector and audio amplifier and having a rather elaborate feedback system from the voice coil to a tapping on the volume control.

The owner complained of poor volume and intimated that the loss of volume had been quite sudden. All this seemed straightforward enough and I didn't anticipate any particular difficulty. Probably an audio plate resistor "gone high" or something equally obvious, I told myself, and set it up on the bench to see what it had to say for itself.

It was certainly weak — very weak — but there was no evidence of distortion that usually accompanies a high plate load. Maybe it wasn't going to be so obvious after all. However, it didn't take me long to establish that the loss was in the audio section, the response from the pick-up terminals being equally sick.

AUDIO TEST

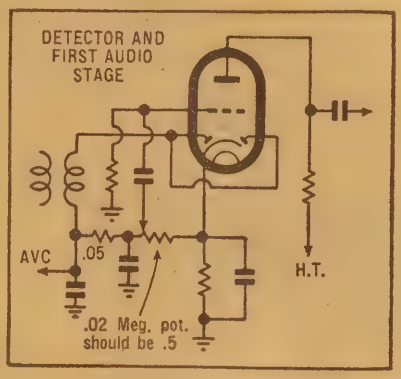
Some audio fed into the various parts of the system narrowed the trouble still further, there being every evidence that the 6B6 stage was not contributing its share. The valve itself tested OK and a known good one, substituted to make sure there was no obscure fault not revealed by the tester, performed in exactly the same manner.

By now the problem was beginning to assume serious proportions. It was obvious that the 6B6 was not doing its job, yet the valve itself was OK. The plate load resistor was normal, as was the grid resistor, while signals were equally strong from both sides of the coupling condensor between grid resistor and volume control. Where, then, was the fault?

At this point I enlisted the aid of the VTVM. The circuit was one employing simple AVC, that is, a circuit in which a common resistor network performs the dual function of AVC load and audio load, and decided that there might be some merit in knowing what was going on in this part of the circuit.

Accordingly I tuned in a local station and measured the voltage developed across the load resistor, this consisting of the .05 meg. decoupling resistor and the .5 meg. volume control. The voltage was about 15 which might have been a little on the low side but certainly not enough to arouse my suspicions.

Then I measured across the volume and found my first real clue to the trouble. Instead of being almost the same voltage it was now



A low resistance volume control ruined the performance of this circuit.

only a fraction of the previous reading. (I forget the exact value, but it was a long way down.)

Thus encouraged I measured the resistance across the volume control. Instead of the expected .5 meg. it was a mere 20,000 ohms. No wonder the audio was weak!

LOW RESISTANCE

But I still had to find the reason for this low value. It seemed almost certain that it would be a faulty shielded cable or a partially shorted condenser in the diode decoupling network so I disconnected all leads from the pot. and checked the resistance across them. They were above suspicion, no sign of a short or leakage of any kind, so, more or less in desperation, I measured the pot. And there was the trouble, the pot. was 20,000 ohms.

After that, of course, it was a plain sailing and a new pot. of correct value restored the set to normal performance. But how on earth had the pot. come to have that value? The customer had said nothing about any previous repairs to the set and in fact, the pot. was the correct brand for the particular set and had every appearance of having been there since the set was new.

TOO BIG A CHANGE

On the other hand I have yet to be convinced that a pot. can up and change its value from .5 meg. to 20,000 ohms overnight (or over any period of time for that matter).

While I am not prepared to say that a carbon resistor can't drop in value, the natural tendency of these devices is always to increase, and even then the change is normally only a few percent unless something drastic happens and they go virtually open circuit. But a decrease of that order is something I can't accept.

In view of all this I could only conclude that someone else had worked on the set and when the owner came to collect it I raised the point. No, he said, he was quite sure that nothing like that had happened. The set had simply lost its volume quite suddenly and I was the first person who had touched it.

YOUR GUESS?

After he had gone I went back to the bench and had another look at the pot. I measured it again, both right across and from the centre tap. The total resistance remained stubbornly at 20,000 ohms and the variation with the movement of the centre tap was quite smooth. In other words, I could find nothing abnormal about it and as far as I'm concerned it was made a 20,000 ohm pot. and has always been a 20,000 ohm pot.

On the other hand I have no reason to doubt the owner's statement, and he had no cause to be anything but frank about it.

So what is the explanation? Frankly, I don't know. With all that conflicting evidence one can only guess and your guess is as good as mine.

ELECTRONIC AIR CONDITIONING

MOVING charged particles by electric fields as a basis for cooling and air-conditioning has captured the imagination of several industrialists in the US. A few firms are actively working toward such an electronic air-conditioner.

Other somewhat similar devices have been used. Electrostatic precipitators to filter dust particles from incoming air are available. Some years ago, arc-discharge machines designed to produce ozone for kitchen sanitation were marketed.

Other electronic equipment usually considered commercial is used in factories and offices, and, occasionally in the home. This includes electronic burglar alarms, photo-electric fire-warning systems and intercummunication units — used in many instances for baby-sitting. A number of electronic garage-door openers are in use.

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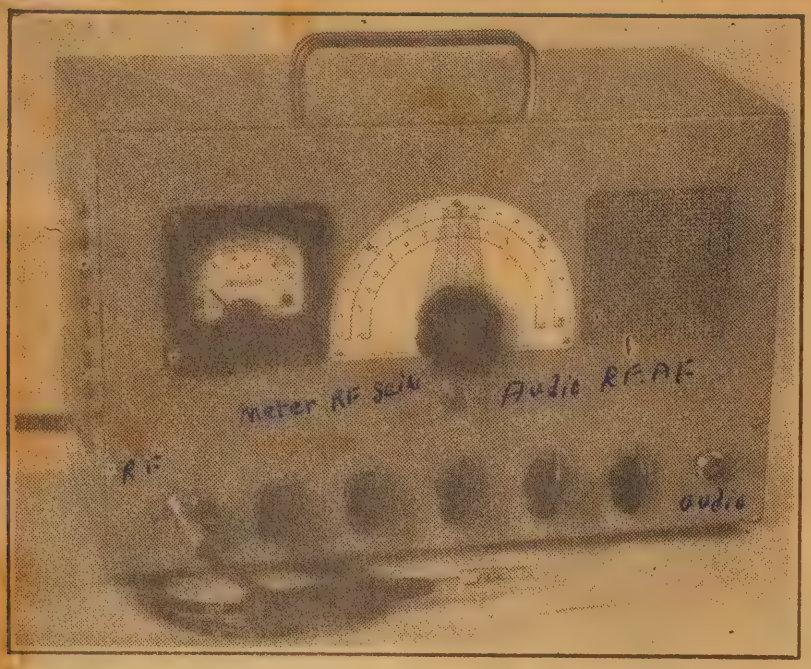


Since last month, the speaker on/off switch has been shifted to make way for the wave change switch, the panel engraved and the short-wave calibrations added to the tuning scale.

In the case of car receivers, of course, the vibrator is a possible cause of a low high tension voltage.

Some servicemen make a practice of testing all the valves in a receiver before going any farther and replacing any which fall below the doubtful line on the tester scale.

FAULTY VALVE?

Testers are not always infallible and, in certain positions in the receiver, valves which are a little low in emission will work as well as new valves and for almost as long. This applies particularly to the audio voltage amplifier, which is often called upon to handle very small currents and therefore normally has a reserve of emission.

A decision can be made only with a knowledge of the receiver and the customer's requirements but, if valve replacements are carried out strictly in accordance with the readings of the tester, you will replace more valves than really necessary.

However, we are in danger of starting a discussion on the ethics of radio servicing.

Should you find that the high tension voltage is only a little off the normal figure, it is usually best to simply make a note of the fact and go on to find the real cause of the trouble. For example, it is most unlikely that a drop in high tension from 250 to 200 volts would render a receiver inoperative unless perhaps the oscillator section of the converter is in very poor condition.

In a well-organised repair organisation the foregoing will occupy at the most 15 minutes and in the greater percentage of cases will serve to find trouble. It is the obscure troubles, which fortunately are in the minority, which cause the greatest waste of time.

USING YOUR SIGNAL TRACER

Any radio serviceman worthy of his salt will have developed his own special technique for cutting down the time taken for fault finding. Competition being what it is these days, he wouldn't remain in business very long if he didn't. We don't propose therefore to write a universal treatise on the art of servicing but merely to outline methods of using the new instrument for those who have had little previous experience.

by Maurice Findlay

PERHAPS we could best start by explaining when not to use a tracer.

Obviously, if a radio comes into your workshop belching smoke from the power transformer, you won't start thinking how to set the controls of the signal tracer.

You will probably approach a faulty chassis with caution and proceed slowly, at least until you are sure that it isn't lethal or likely to explode. You will probably keep your hand on the switch after plugging in so that you can remove the power as soon as possible, if there are any fireworks.

OBVIOUS SIGNS

If nothing spectacular happens, you will start to look for components overheating. For example, if the screen of the output valve glows brightly, you won't need a signal tracer to tell you that the primary winding of the output transformer is open circuited.

In the same way, a dropping resistor overheating may lead you to a shorted screen bypass capacitor or a heated electrolytic may indicate that the leakage current is greater than normal.

It is a good idea to check the high tension voltage. Your experience of receivers in general will give you a good idea of what this should be. If too low, it may be due to a rectifier valve low in emission or perhaps the first electrolytic capacitor low in capacity. If too high, it is likely that the output stage is not drawing its rated current.

The bias could be too high due to a back bias resistor which has drifted high in value. Another possibility is that the valve is down on emission.

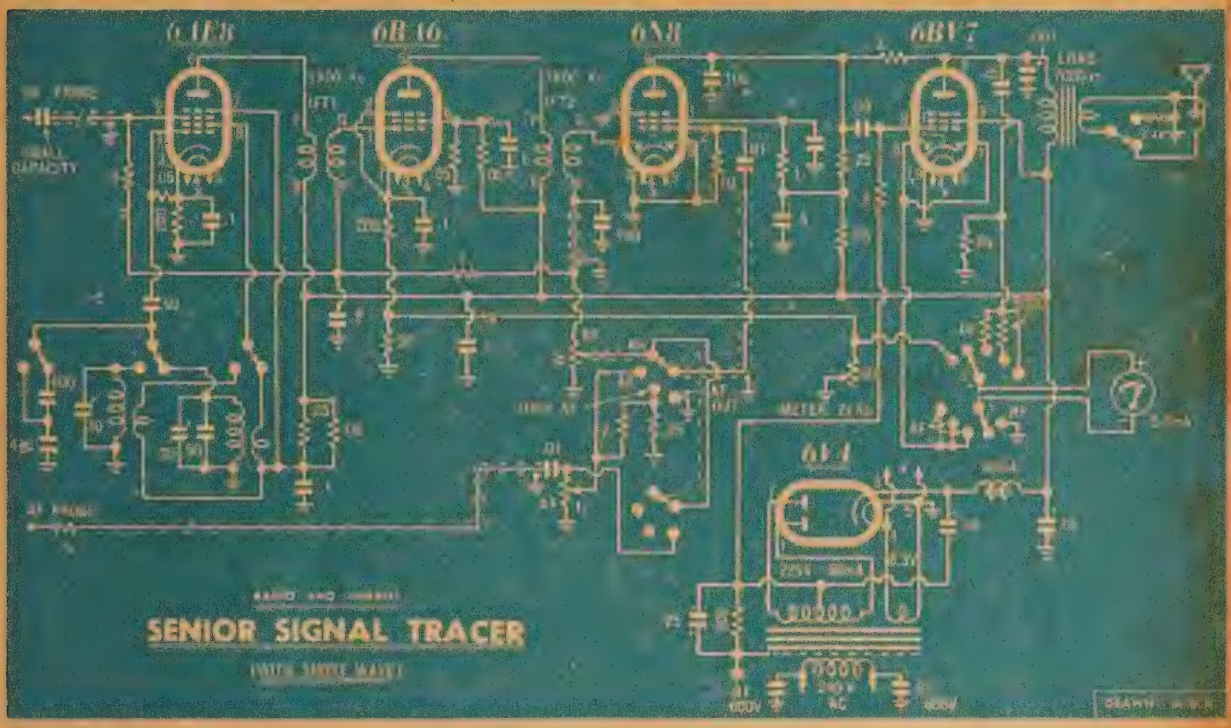
AUDIO AMPLIFIER TEST

Assume there is no fireworks, and to the eye the set appears normal, but it will not produce any signals. Your next test will probably be to place a finger on the "hot" lug of the volume control. If this results in a loud hum or squeal in the output you can be almost certain that the trouble is in the RF section of the receiver.

By the same reasoning, no response indicates that something is wrong with the audio end.

At this point, and assuming that the trouble is still not obvious, you

CIRCUIT DIAGRAM OF SENIOR SIGNAL TRACER



The new circuit includes a short-wave band and switching to direct the output of the tuner to the audio probe. It is a simple matter to modify tracers built to last month's circuit to conform with the above.

can pick up the probe of the signal tracer.

If the trouble appears to be in the RF section, you can start by placing the probe on the aerial terminal. Unless the primary winding is short circuited you will be able to tune in all the local stations.

Transfer the probe to the grid of the mixer or RF amplifier and you will note that the strength of the signal reaching the tracer depends on the setting of the tuning capacitor and at maximum is greater than the signal at the aerial terminal.

If there is no signal or a weak signal at this point you could start looking for such things as shorted coil, open circuit coil, shorted trimmer or tuning capacitor or perhaps a short between the grid and cathode of the valve.

NEED FOR EARTH

By the way, with AC operated receivers the tracer will usually operate normally for RF tests at least without any special provision for an earth. This is due to the capacity between the chassis and the primary of the power transformer. However, for audio tests on receivers without earth lead in the power cable it is desirable to clip a special lead between the tracer chassis and the chassis of the set under test. With battery-operated receivers this connection is essential.

If the first valve is an RF amplifier, the signal at the plate should be considerably increased in strength. If not, you can start checking with the multimeter for all the usual things that would render an RF amplifier inoperative. Open circuit cathode resistor, screen dropping resistor, RF coil primary or a short in one of a number of places would cause the trouble.

If the signal is present, but only about the same strength as at the grid, do not overlook the possibility that the AVC has reduced the gain of the valve. Try the relative strengths at the grid and the plate again, but with only a foot or two of aerial attached.

COIL DATA

BROADCAST COIL

Tuned winding: 26 turns 35 SWG enamel closewound on ¾in diam. former.

Feedback winding: 24 turns 40 SWG enamel closewound 3/32in from earthed end of tuned winding.

SHORT-WAVE COIL

Tuned winding: 9 turns 25 SWG enamel spaced to occupy ¾in on a ¾in diam. former.

Feedback winding: 4 turns 35 SWG enamel interwound with above from earthed end.

At the plate of the mixer valve the signal at its original frequency will be present, but not particularly strong. However, it should be possible to get a strong signal by tuning the tracer to the intermediate frequency. (Usually about 455 Kc.)

It is also possible to observe the signal from the oscillator section of the converter at this position. It will not be modulated and therefore will produce no output in the speaker, but its presence should be amply evident by the deflection of the meter, switched to the RF position.

For this reason the plate of the converter is a particularly valuable test point, and, in developing a service technique, you would be wise to make full use of it.

TESTING THE OSCILLATOR

From the plate of the converter you can follow the signal on to the grid of the IF amplifier, the plate of the IF amplifier and the diode detector. Disappearance of the signal at any point isolates the trouble to a small number of components, and it doesn't take long with the multimeter to pin it down.

From the diode detector, and including this position, the audio probe takes over. It is simply a matter of following the signal from grid to plate through to the output stage and by noting where the signal disappears or becomes distorted you can narrow the possibilities down to a few components.

A point to watch is that none of the valves in the set is overloaded. If, for example, a distorted signal appears at the plate of the audio voltage amplifier stage, try turning the receiver gain control down before you decide that something is wrong.

Intermittent receivers can be one of the biggest timewasters in a radio service orgahisation. Much time can be saved by the intelligent use of signal tracer technique.

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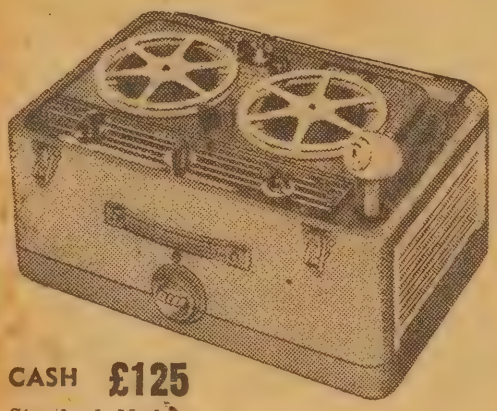

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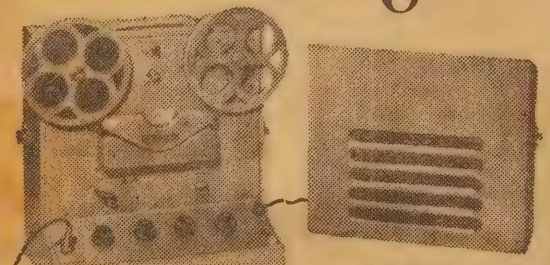

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Both probes of the present tracer can be attached to convenient parts of the set and the RF and audio gain controls set so that the output meter readings are the same with the function switch set to take the output of either. If any variation occurs in the duration of the test it is a simple matter to determine the section of the set responsible.

With two probes the set is divided into three parts and so you have a much narrower field of test. By further shifting the probes you can get still closer to the position of fault until finally there are only two or three components.

VALUE OF SHORTWAVE

Since the publication of the article in the May issue we have had the opportunity to make further use of the tracer and also to add a couple of features to it.

The first is a short-wave range to enable the RF section of receivers to be checked when switched to the shortwave position.

True, a fault which appears only in the short-wave section is not likely to be too hard to find without the tracer. However, there is so little extra involved in the way of components and effort to add the extra range that many will wish to include it as we did.

One of the most useful features of the shortwave range is that it enables you to check the frequency of the oscillator section. You simply place the probe on the stator plates of the gang and tune for maximum response on the RF meter, after which you can read the frequency from the calibrated dial of the tracer.

As there is no tuned circuit in the input, the tracer responds equally well to signals higher and lower than the oscillator by the intermediate frequency. For example, with the oscillator at 10 Mc, signals at 12 Mc and 8 Mc will respond equally well if the tracer's intermediate frequency is 2 Mc.

ADDITIONAL FEATURE

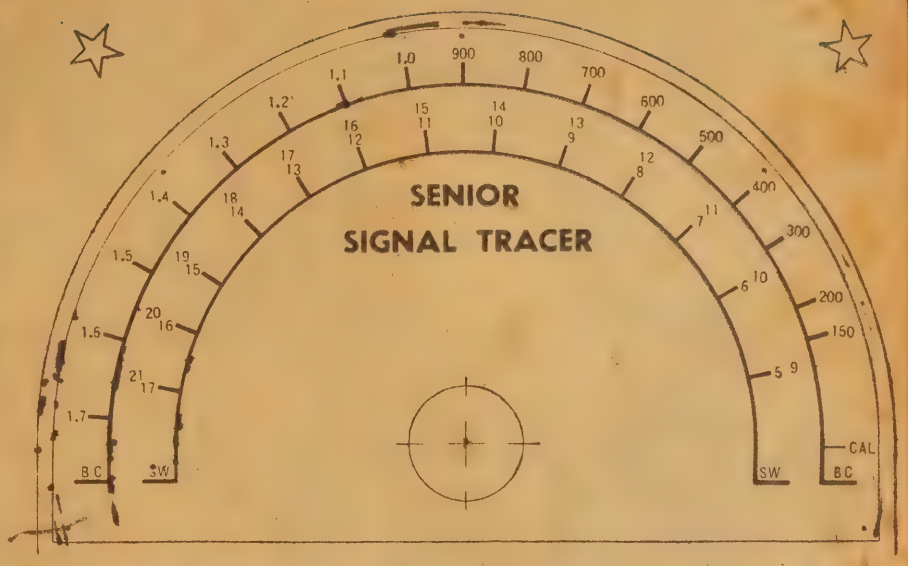
For this purpose, you can get over the difficulty by marking each calibration point with the possible frequencies. You will see that for any one frequency there will be two possible positions on the dial and only two.

There is no ambiguity if you tune to both positions and note the frequency which appears in both cases.

As a second feature, we have modified the wiring of the function switch slightly to allow signals from the first section of the tracer to be fed out via the audio probe.

The RF section of the tracer can thus serve as a tuner and the output from the RF probe be fed into amplifiers for test purposes — a small point but, since the standard switch you will use has the extra position and only two extra wires are involved, it is well worth while.

So much for a general discussion of the instrument.



A full size reproduction of the scale of our original laboratory instrument. It would serve for all instruments using the AWA tuning capacitor. Copies on art paper can be supplied through the 2/- query service.

Very few receivers which have developed faults in normal use find their way into Radio and Hobbies laboratory so, in order to try the tracer under normal conditions we took it along to a professional radio serviceman acquaintance of ours and tried it out on a couple of sets that came in as part of his routine work.

Neither of the sets was extremely difficult to repair but a description of the procedure used should serve to illustrate the practical use of the new instrument.

Case 1: A very charming lady dropped the set into the shop during a morning shopping round with the usual "It's probably only a valve — worked wonderfully for years and never given a scrap of trouble!"

The set turned out to be a five valve mantel using standard octal-based valves. It looked as though it had been "custom-built" but whoever had done the job knew his business.

There was a fair amount of dust inside the cabinet and on the chassis, so the first job was to remove it from the cabinet. The wiring turned out to be up to the standard of the rest of the set.

A visual check around the chassis did not reveal any signs of overheating and a check with the multimeter showed that the resistance between the high tension line and earth was about .1 megohm in either direction. It thus appeared quite safe to switch the set on.

TEST PROCEDURE

It was noted, incidentally, that the power cord was only of the ordinary two-core variety, so the earth lead attached to the service bench was clipped on to the chassis just to make sure that there would not be any peculiar effects when the signal tracer was connected later.

The set warmed up without any sign of protest, but, as the lady had said, was as dead as the oft-quoted doorknob, even with the efficier acrial available at the service bench The high tension measured 220 volt a little on the low side, but probabl normal, in view of the fact that th power transformer fitted seeme fairly small.

A finger placed on the grid of th audio voltage amplifier produced n response. The obvious conclusion therefore, was that the trouble wa in the audio section of the set.

Note that up to date no referenc has been made to the signal tracer.

BEWARE OF DISTORTION

However, at this point the se was tuned to coincide with a loca station at about the middle of th dial and the RF probe of the trace placed on the diode (the tracer tune to 455 Kc) produced a healthy signal when the tuning of the re ceiver was adjusted by a smal amount. Similarly, the audio prob placed in the same position produce a clear signal in the output of th tracer.

It was a matter of a couple o seconds to verify that an undistorte signal was present at both the to of the volume control and the centre lug.

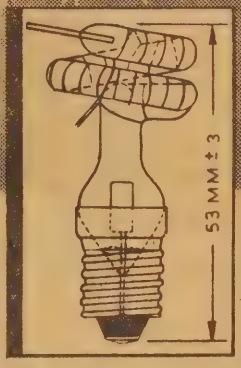
While making the last test, the volume control was tuned to the full-on position, with the set tuned accurately to a station, for the first time. It was noted that a hissing sound, obviously corresponding wit the peaks of audio output in the tracer, was coming from somewhere in the audio end of the set.

Only at the plate circuit of the output valve could sufficient power be developed to cause such behavior so attention was directed to this part of the set.

By the way, with the audio probe in hand and the tracer set, it was simply a matter of placing the probe on the grid of the output valve to make sure that the signal was still in order at this point.

SIEMENS

SIEFLASH TUBES



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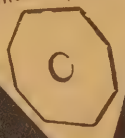

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At first the output from the tracer was distorted regardless of the setting of the tracer control. It was soon realised that this was due to the audio voltage amplifier being overloaded and a readjustment of the volume control on the set was all that was needed to restore an undistorted signal.

Similarly, the probe was touched on the plate of the output valve and, with the receiver's volume control turned down still further, the signal was okay.

There was no doubt, then, that the primary circuit of the output transformer was in order. Had it been open circuit we would probably have noticed the screen of the output valve glowing red-hot when the set was first switched on.

TIME SAVING

The only remaining possibilities were the secondary of the output transformer or the speaker voice coil.

The chassis was turned right side up, so that these could be inspected, and it was only a matter of a few seconds of gentle pushing with a test probe to reveal a poor solder joint between the lead from the speaker transformer and one of the voice coil lugs. The joint was carefully resoldered and the set worked perfectly.

Although not strictly necessary, the valves were checked and the set realigned before being returnd to the customer, who rewarded our efforts with such a great big smile as to make it difficult to keep strictly to professional matters.

The whole procedure on the service bench had not taken more than about 10 minutes, despite the fact that we had not made any particular effort to hurry. No doubt the trouble could have been found with the aid of a multimeter, but could it have been found with as great a certainty and as quickly?

The psychological effect of quickly narrowing down the trouble to one or two components is invaluable, especially toward the end of a long and busy day.

True, the hissing sound, which was probably an intermittent arc between the plate and screen wires inside the valve, would probably have led an experienced serviceman to the trouble without too much delay in this case.

PROBE LOADING LOW

But in a small set you could strike a case of a speaker voice coil open circuit but insufficient power developed to rattle the transformer laminations or cause the voltage to rise to the point of arcing over inside the valve.

Case 2: A five-valve dual-wave console chassis collected from the home of a new customer. When first operated on the service bench after the usual preliminary checks it played a couple of the local stations with fairly normal quality, but the gain appeared to be a little down for a five-valve job.

Of greater significance was the fact that only two or three stations were audible and these tuned very broadly.

Immediately, the oscillator section of the receiver was suspected and we thought perhaps that the padder capacitor had a fault making it low in value. But before substituting a new padder we decided to check the operation of the oscillator section with the signal tracer. It is simply a matter of touching RF probe of the tracer on the stator plates of the tuning capacitor.

The loading of the RF probe is so low that, at broadcast frequencies least, it can usually be neglected.

However, in this case tuning ov the range of the tracer produced response at any of several settings the receiver dial. The receiver ar

(Continued on Page 107)

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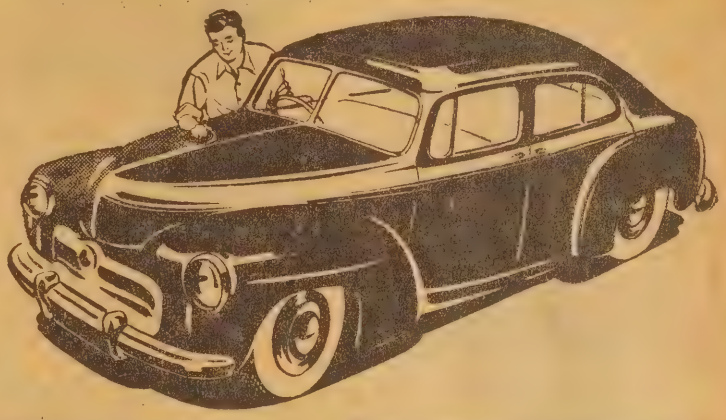

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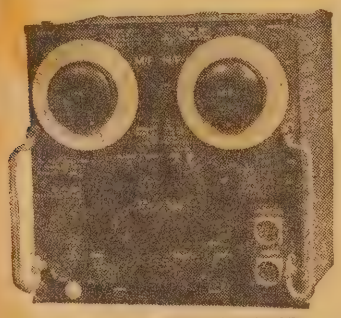

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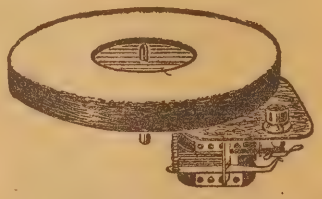

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24	25	1d	1d	1d
26	27	1d	1d	1d
27	29	1d	1d	1d
28	30	1d	1d	1d
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A COURSE IN TELEVISION

PART 50 — THE NTSC COLOR SYSTEM (Cont.)

Having discussed, last month, the production of the brilliance signal and the selection of precise transmission standards, it now remains to examine those circuits in the transmitter which have to generate signals proportional to the color values in the original scene.

IT will be recalled that three camera tubes are used in a complete color TV camera, each "viewing" and scanning the scene in one of the additive primary colors—red, green and blue.

One output link from each picture tube feeds their respective signals to an adding or mixing circuit to produce a signal equivalent to the total brightness of the area being scanned, irrespective of color. This constitutes the main signal required to operate a monochrome receiver.

The contribution which each primary color makes to this aggregate signal is carefully graded so that the grey tones in a monochrome reproduction will follow accepted photographic practice. The proportions are of the order: Green 0.59, red 0.30, and blue 0.11.

SECOND LINK

To feed the color sensitive circuits, a second output link is taken from the cameras, as shown. The processes through which these signals then pass, both in the transmitter and the receiver, are extremely complex and it is not possible, in a readily "digestible" article, to give the reader more than a general picture of how the system works.

Possibly the simplest approach is to base the initial explanation on figure 3, which represents a straightforward approach to the NTSC principles. It should then be possible to understand the NTSC system in its final form, involving as it does an important trick of circuitry to save on bandwidth.

As mentioned in an earlier article, the human eye finds it very difficult to resolve intricate color patterns or detail.

At the same time it is very sensitive to changes in brightness and there is good reason to believe that most of the fine detail we see is resolved on the basis of brightness rather than color.

Whatever the precise explanation, it accepts without question a color image made up of rather poorly-defined color areas, "overprinted" with a high definition brightness pattern.

Experiments have indicated, too, that the perception of the eye varies a good deal with the colors involved.

A pattern involving blue and yellow detail is soon lost because the eye resolves them both as grey. A similar lack is evident with combinations of brown with crimson or blue with green; on the other hand its resolution between green and red is much better.

LOW-PASS FILTERS

Since there is obviously no point in transmitting color detail which the eye cannot resolve, the NTSC system provides for the insertion of low-pass filters in the links between each of the camera tubes and the color signal circuits. These are shown in figure 3.

It is entirely possible to grade the filters to the requirements of the particular color and typical high frequency limits can be set at between about 500 and just over 1000 Kc, representing a very substantial saving in the ultimate bandwidth required by the color information.

However, neglecting the finer details, it is obvious that video signals will be available from the three camera tubes, corresponding to the red, green and blue versions of the original scene. These video signals, containing frequencies up to about 1 megacycle, have to be modulated on to the color sub-carrier.

For the reasons given last month, this color sub-carrier is held to the very precise frequency, for the US standards, of 3.579545 Mc.

SPECIAL MODULATORS

The color video signals are applied to the color sub-carrier by a system of balanced modulators which achieve three objectives:

(1) Vary the phase of the sub-carrier, as finally radiated.

(2) Vary the amplitude of the sub-carrier.

(3) Suppress the residual sub-carrier, leaving only the sideband energy.

Let's refer again to figure 3 which, you will remember, is one step removed from the NTSC type transmitter in its final form.

The signal from the sub-carrier oscillator is shown as being fed in sequence to the three color sub-modulators firstly, for the sake of illustration, to the one handling the red signal.

A further link, involving a delay line or lumped inductive circuit, carries the signal to the "green" modulator, but appreciably out of phase with the signal to the "red" modulator.

A further link applies the signal to the "blue" modulator but with a still further phase difference.

NO MODULATION

In the absence of light from the original scene, all color circuits are dead, there is no modulation of the color sub-carrier, no "color" sidebands and the main picture carrier is deeply modulated to the full black level. (Assuming negative modulation.)

If now the camera is focused on to a deep red surface, the reflected light will pass through the red filters only, to register on the associated camera tube. This latter will supply a corresponding "brightness" signal directly to the main transmitter and also a second signal to the associated balanced modulator.

The balanced modulator actually behaves like a gating circuit which feeds modulated energy from the sub-carrier generator to the main

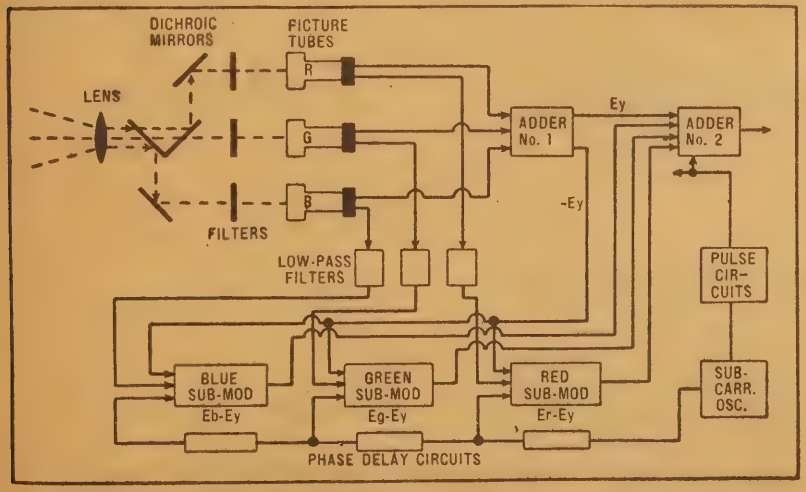

Figure 3: This diagram illustrates the fundamental principles of a color TV transmitter, based on the NTSC approach, but assuming that signals are sent for each of the three primary colors. The final NTSC type transmitter will be described in the next issue.

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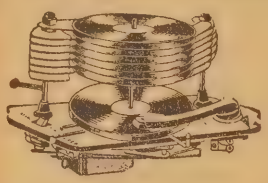

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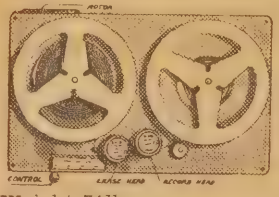

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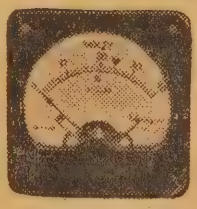

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modulator. Under the conditions assumed by figure 3, sub-carrier components passing through the "red" sub-modulator would be applied to the main carrier with a minimum phase displacement.

This characteristic degree of phase displacement ultimately provides the first essential clue to the receiver—the predominant color is red!

It should be noted also that a proportion of the total brightness information is fed to the sub-modulator but in reversed phase, so that it tends to cancel some of the red signal. This produces a form of amplitude modulation which is quite independent of the phase modulation.

It becomes, in fact, a measure of the degree of saturation or dilution of the particular color.

"RED" OUTPUT

Thus a deeply saturated red background would produce only a limited degree of brightness but a high amplitude "red" signal. There would be a minimum of cancellation in the "red" sub-modulator and therefore a strong "red phase" component in the output of the sub-modulator.

A pink shade, on the other hand, would produce a much higher brightness signal (due to white dilution) and there would be more complete cancellation of the red signal. The color information would thus be characterised by weak "red phase" component.

The technique of adding to each color signal an out-of-phase component from the total brightness signal gives rise to the term "color difference" signals.

Looking at figure 3, the total brightness signal is denoted as Ey. The out-of-phase component of this is, therefore, -Ey.

The original color signals are denoted as Er, Eg and Eb (for red, green and blue voltages) but the "color difference" signals which leave the sub-modulators are Er-Ey, Eg-Ey and Eb-Ey.

At the receiving end, it is the job of color sensing circuits to construe the signals as follows:

(1) Sub-carrier phase? Characteristic of red.

(2) Sub-carrier amplitude? High, indicating saturation.

(3) Brightness? Moderate.

In other words, given suitable circuitry, the receiver can extract from the radiated signal information as to (1) brightness, (2) hue and (3) saturation. This is all it needs to "know" at any particular instant.

"GREEN" SIGNAL

Were the camera now focused instead on to a green or a blue background, brightness and saturation might remain substantially unaltered, but there would be an immediate difference in sub-carrier phase, because the signal would be passing through a delay line and a different balanced modulator.

This change in phase of the sub-carrier would be the signal to the receiver to activate the green or blue gun, as required. So much for single primary colors.

Where the hue to be transmitted involves more than a single primary color, it will produce a response in more than one color camera tube.

Signals will, therefore, reach more than one of the balanced modulators and the sub-carrier will undergo separate modulation in each, according to the proportions of the primary colors involved.

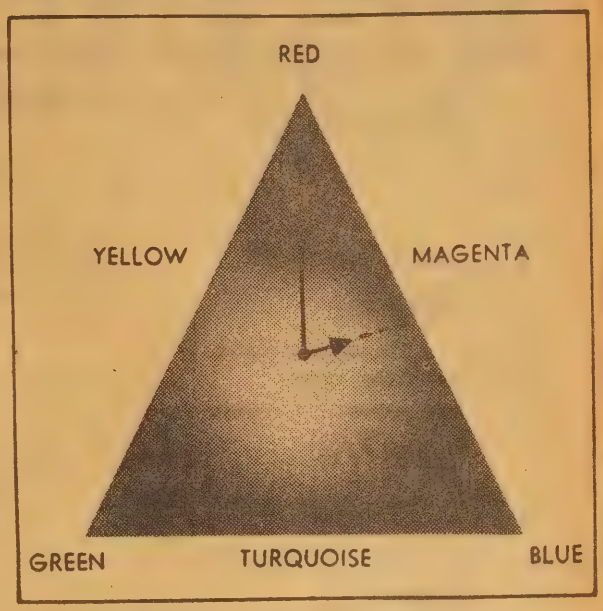
When these separate modulation components are then combined in the final television signal, the sub-carrier will be found to have assumed a phase intermediate between the phases representing the predominant primary colors.

As before, its amplitude will indicate whether the color mixture is close to saturation or highly diluted.

It is the job of sensing circuits in the receiver to activate electron beams for the same predominant primaries, and in the proportion represented by the intermediate phase displacement of the sub-carrier.

HOW VECTOR DESCRIBES COLOR

This diagram combines the conception of a color triangle with that of a rotating vector, which points to the shade involved at any particular instant and indicates the degree of saturation by varying its length. The points of the triangle should be envisaged as being colored, as indicated, with intermediate shades in between.



DIFFERENT SHADES

For a deeply saturated shade, only two color phosphors may be activated in the picture tube. For a pastel shade, the limited amplitude of the color signals, plus a high overall brightness would be the signal to the receiver to activate the third phosphor to a limited degree, thereby tending to "whiten" the color.

In point of fact, the action of the sub-carrier modulators may be likened graphically to a vector operating inside the familiar color triangle, as shown in figure 4.

As the phase angle of the sub-carrier is varied by the action of the sub-modulators, the vector line may be envisaged as swinging to and fro between the apex points of the color triangle.

As the diagram is drawn, vertically upward happens to be red, to the lower right blue and in between all the intermediate magenta-like hues. Similarly for yellow, green and cyan.

Obviously, of course, while only six hues are specifically mentioned, the vector can assume an infinite number of angles, representing a very wide range of hues.

Any of these hues can be deeply saturated, involving one or two primaries, or it can be diluted toward the "white" region by the presence of the third primary.

Looking at figure 4, it is easy to appreciate that tones through the grey scale to white involve substantially equal proportions of the three primaries, but with varying degrees of intensity according to the dictatee of the brightness signal. White would represent maximum brightness, black zero brightness.

So much for the provisional explanation, based mainly on Figure 3. In the next issue we will see how these basic ideas are further modified to produce what is now accepted as the official NTSC practice.

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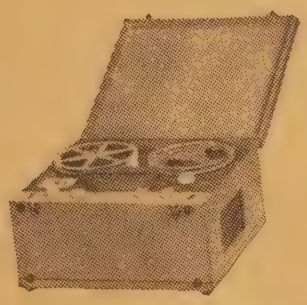

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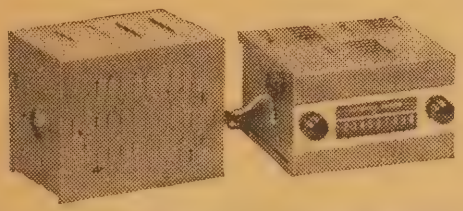

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HIGH RESISTANCE DC VOLTMETERS

The development of meter movements having a full-scale deflection sensitivity of only a few microamperes has made possible the design of direct-reading voltmeters having an extremely high value of input resistance. The design of such voltmeters is discussed in this paper by Engineers of the Aerovox Corporation.

A VOLTMETER used to check high-resistance electronic circuits must have high internal resistance, in order to minimise circuit loading. The DC vacuum-tube voltmeter meets this requirement and has been obtainable in the service category for about 15 years.

Most of these electronic voltmeters have input resistances of 11 megohms, constant for all ranges, although some service-type models go as high as 20 megohms.

The non-electronic DC voltmeter offers the advantages of complete portability, simplicity, freedom from drift and zero adjusting, and the ability to operate without any sort of power supply.

These features often are definitely required in field testing and are desirable also in the laboratory when removal from power line and batteries is a requisite. But the common non-electronic voltmeter has relatively low input resistance.

SENSITIVE METER

It is of interest to note that a non-electronic DC voltmeter having high input resistance can be obtained with a sensitive DC microammeter and high-resistance multiplier.

The full-scale deflection of the microammeter must be somewhat lower than is common in meters ordinarily used in conventional voltmeters. Thus, a 0-10 DC microammeter with a 25-megohm series resistor provides a 0-250 DC voltmeter.

Note that the input resistance in this case is higher than that of the conventional DC vacuum-tube voltmeter. The instrument sensitivity is 100,000 ohms per volt.

Ultra-high-resistance, non-electronic DC voltmeters of this type are entirely practical. Multiplier resistors may be switched in the instrument circuit, in the conventional manner, to change ranges.

DC microammeters are now available in the US with full-scale deflections of 2, 5, 10, 15, 20 and 30 microamperes.

Figure 1 shows the circuit of a multirange ultra-high-resistance DC voltmeter having 100,000 ohms per volt sensitivity. A 0-10 DC microammeter is employed.

VOLTAGE RANGES

The voltage ranges provided are 0-1, 0-5, 0-10, 0-50, 0-100, 0-250, 0-500 and 0-1000 volts. Other ranges, more desirable to the reader, can be added or substituted for those shown.

The multiplier resistor values are calculated by means of Ohm's Law, R equals E/I where R is the required multiplier resistance in ohms, E is the desired full-scale voltage deflection in volts, and I is the full-scale current deflection of the microammeter in amperes.

Figure 4 is a chart listing calculated multiplier resistance values for 23 common voltage ranges for use with sensitive microammeters of six different full-scale deflections.

The internal resistance (rm) of high-sensitivity microammeters is comparatively high. In the 0-10 microammeter, for example, this value lies between 2000 and 4000 ohms, depending upon manufacture and model number.

For best accuracy, the meter resistance value, rm must be subtracted from the calculated multiplier resistance, R, whenever R/r is 100 or less.

Thus in Figure 1, the calculated value of the 1-volt multiplier would be 100,000 ohms. But the meter internal resistance is 2000 ohms and 100,000/2000-50, so we must subtract the meter resistance, giving the accurate multiplier value of 98,000 ohms.

On each other voltage range, R/rm is higher than 100, so the calculated multiplier resistance values are used.

Figure 2 is a table showing pertinent data for commercially available sensitive DC microammeters with full-scale deflections between 2 and 30 microamperes.

Displayed in this chart are the internal resistance (rm) values and the voltmeter sensitivities (in ohms per volt), which the meters will provide in voltmeter circuits. All except the 2 microampere model are panel-type instruments.

The 0-2 microammeter is a portable case-type, but can be mounted on the panel of an assembled u.h.r voltmeter.

Figure 3 shows a useful variation of the u.h.r voltmeter circuit. Here, a centre-zero type of microammeter is employed. The right half of the scale is graduated from zero up to the maximum positive voltage, and the left half from zero down to the maximum negative voltage of the same value.

READS EITHER WAY

When a test voltage is applied so that the upper input terminal is positive, the meter is deflected upscale to read the voltage. If the voltage source is reversed, the meter is deflected down-scale and reads the same voltage but with negative sign.

Thus, no changeover of test leads is needed.

The last column in the chart in Figure 2 shows the voltmeter sensitivity which is afforded by available high-sensitivity microammeters.

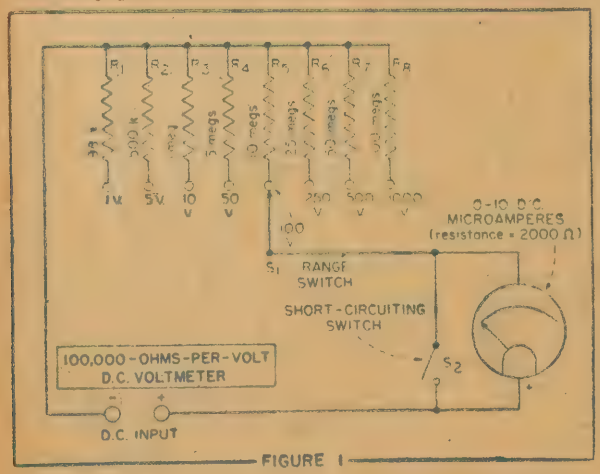


FIGURE 1

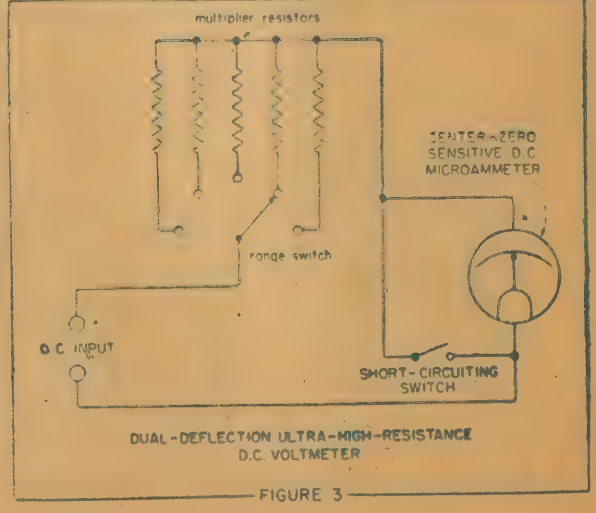


FIGURE 3

Two typical high resistance circuits.

SCALE (μa.)	METER RESISTANCE, r_m (ohms)	VOLTMETER SENSITIVITY (ohms per volt)
0—2	10,000	500,000
0—5	8000	200,000
0—10	2000—4000	100,000
0—15	5000	66,666
0—20	1520	50,000
0—30	1520	33,333

TABLE OF MICROAMMETER DATA

FIGURE 2

These sensitivities are obtained on each range of voltmeters employing the meters.

The input resistance changes with each range of the voltmeter, however, since it is equal almost entirely to the resistance value of the multiplier. The multiplier values listed in the chart in Figure 4 show the input resistance which a given voltmeter will have on each range.

If we take 10 megohms as the approximate input resistance of a DC vacuum-tube voltmeter, we find that this value will be equalled on the 20-volt range using a 0-2 microammeter, the 50-volt range with a 0-5 microammeter, 100-volt range with 0-10 micro-amperes, 150-volt range with 0-15 microamperes, 200-volt range with 0-20 microamperes, and 300-volt range with 0-30 micro-amperes.

In each instance, all higher-voltage ranges will have higher input resistance than the v.t. voltmeter. These relationships point up the necessity for using the lowest-range microammeter that can be afforded for this application.

The combination of extremely sensitive microammeter and very high multiplier resistance is not commonplace.

PRECAUTIONS

Certain precautions are necessary in the construction of voltmeters employing this combination, which do not arise in connection with voltmeters up to 20,000 ohms-per-volt sensitivity. These precautions are outlined below.

1. Special instrument-type resistors are required. (They may not be immediately available in Australia.—Ed.) Be sure that the outer surfaces of these components are cleaned carefully after soldering into place.

Try not to touch the surfaces with the bare fingers, to prevent depositing greasy or moist finger prints. After installation, wash the exterior portions of the resistors with carbon tetrachloride or any other solvent recommended by the resistor manufacturer.

If the resistors have been coated with a special high-insulation wax, DO NOT TOUCH THE BODIES, and do not use solvent which might dissolve the wax.

2. Use the minimum of heat in soldering the resistors in place. Provide a protective heat shunt by holding the pigtails with flat-nose pliers while soldering. Continue to grip the leads with the pliers until the soldered joint has cooled completely.

3. The range switch must be provided with excellent insulation to prevent leakage paths. Always use a ceramic-type switch for this application, and do not handle the ceramic insulation any more than necessary during assembly of the voltmeter. After installation, wash the ceramic with carbon tetrachloride or lacquer thinner to remove any contamination.

4. The input terminals of the voltmeter must be insulated from the panel material by ample washers or inserts of high-quality dielectric material, such as polystyrene or ceramic.

5. If a metal panel is used, be sure to specify metal-panel operati when ordering the microammeter.

6. Make an air-tight seal of t instrument case to prevent the ent of dust, grease, and moisture whi will tend to create high-resistan leakage paths on the range swit and multiplier resistors.

7. Ascertain from the meter manu facturer whether the microammet can be used in all positions. If t meter is specified to operate in o position only (such as horizontal make a practice of using the vol meter only in that position.

METER SHORT

8. Include a short-circuiting switc to short-circuit the microammet itself when the voltmeter is not i use. Low-range microammeter often are susceptible to fields an transient phenomena, and the sho circuit will protect the sensitiv movement.

Because of the high resistance the multipliers, no damage will b done if a potential accidentally applied to the voltmeter input ter minals while the shorting switch closed.

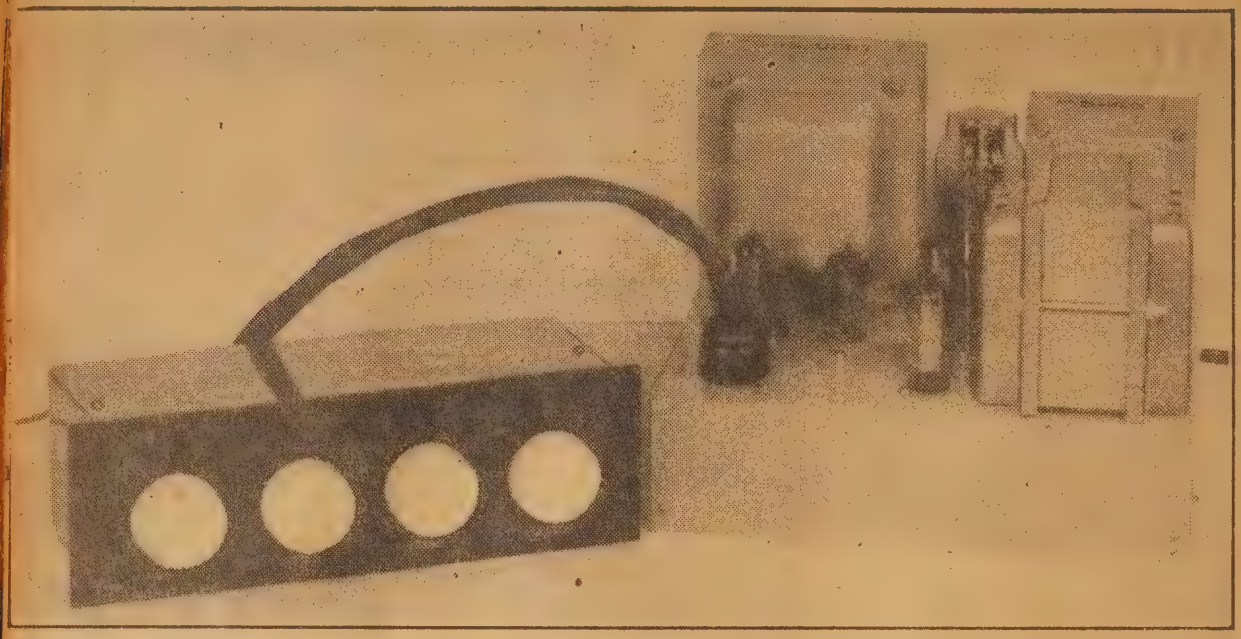
No special technique is required t measure voltages with the ultra high-resistance meter. Manipulatio of the instrument and its care are th

(Continued on Page 106)

VOLTAGE RANGE	BASIC METER RANGES					
	0—2 μa.	0—5 μa.	0—10 μa.	0—15 μa.	0—20 μa.	0—30 μa.
0—1	500 K	200 K	100 K	66.67 K	50 K	33.33 K
0—1.5	750 K	300 K	150 K	100 K	75 K	50 K
0—2	1 meg.	400 K	200 K	133.3 K	100 K	66.66 K
0—2.5	1.25 meg.	500 K	250 K	166.7 K	125 K	83.33 K
0—3	1:5 meg.	600 K	300 K	200 K	150 K	100 K
0—5	2.5 megs.	1 meg.	500 K	333.4 K	250 K	166.7 K
0—7.5	3.75 megs.	1:5 meg.	750 K	500 K	375 K	250 K
0—10	5 megs.	2 megs.	1 meg.	666.7 K	500 K	333.3 K
0—15	7.5 megs.	3 megs.	1:5 meg.	1 meg.	750 K	500 K
0—20	10 megs.	4 megs.	2 megs.	1.33 meg.	1 meg.	666.6 K
0—25	12:5 megs.	5 megs.	2.5 megs.	1.67 meg.	1.25 meg.	833.3 K
0—30	15 megs.	6 megs.	3 megs.	2 megs.	1.5 meg.	1 meg.
0—50	25 megs.	10 megs.	5 megs.	3.33 megs.	2.5 megs.	1.66 meg.
0—75	37.5 megs.	15 megs.	7.5 megs.	5 megs.	3.75 megs.	2.5 megs.
0—100	50 megs.	20 megs.	10 megs.	6.67 megs.	5 megs.	3.3 megs.
0—150	75 megs.	30 megs.	15 megs.	10 megs.	7.5 megs.	5 megs.
0—200	100 megs.	40 megs.	20 megs.	13.3 megs.	10 megs.	6.7 megs.
0—250	125 megs.	50 megs.	25 megs.	16.7 megs.	12.5 megs.	8.3 megs.
0—300	150 megs.	60 megs.	30 megs.	20 megs.	15 megs.	10 megs.
0—500	250 megs.	100 megs.	50 megs.	33.3 megs.	25 megs.	16.6 megs.
0—750	375 megs.	150 megs.	75 megs.	50 megs.	37.5 megs.	25 megs.
0—1000	500 megs.	200 megs.	100 megs.	66.7 megs.	50 megs.	33 megs.
0—1500	750 megs.	300 megs.	150 megs.	100 megs.	75 megs.	50 megs.

TABLE OF MULTIPLIER RESISTANCE VALUES

FIGURE 4



Here is the Control Unit Four connected to the new Playmaster Seven. The panel is smaller than No. 2 and is finished in brown bakelite with gold lettering. It also has a red indicator light.

PLAYMASTER CONTROL UNIT No. 4

This unit attempts to provide a reasonable solution to the vexed question of record playback compensation, both for discs already issued and for those likely to be issued. It is intended to operate with amplifiers with an input sensitivity of about 250-350 millivolts with which its own input sensitivity is 40-50 millivolts.

by John Moyle

THIS story really begins on Page 70 of this issue, in which Neville Williams buys very confidently into an argument about playback compensation curves for gramophone records.

I think he has stated the position very fairly, most comprehensively, and with a great deal of commonsense (to say nothing of the blarney!) It is a position which has been remorselessly growing for several years, and it must inevitably call for rationalisation if we are to make some kind of cosmos from complete chaos.

I have been particularly concerned about it all with the prospect ahead of bringing our amplifier program up to date. Until a solution could be worked out which would make some kind of sense, such a program would be quite futile.

SO MANY CURVES

Main difficulty, of course, lay not so much with the basic amplifiers as with the control units and their compensation circuits. How on earth was it possible to handle such a bewildering array of playback curves without providing a knob for each one? For that matter, how important was it to make any change from the No. 2 Control Unit, which seems to have become pretty well standard with our readers?

Does it really matter if we play EMI records with AES compensation and vice versa? Should we really worry if someone decides to use EMI's bass, but changes to AES' treble?

The answer to the last two posers is both yes and no. With poor to average equipment, I don't think it matters two bits beyond settling on a compromise compensation which sounds best. If we must superimpose wobbly pickup curves and poor speaker set-ups on fixed playback settings we are wasting our time.

But if our equipment is reasonably flat and clean, and capable of appreciating differences of a few db at either end of the scale, then to some degree it does matter. With gear which can be classed as wide-range, some degree of compensation change is quite desirable.

LOOSE STANDARDS

As applied to the Playmaster series, I think we can claim that they are all capable of very fine reproduction. The old LP and two 78 switch positions are no longer good enough. A new set of designs is needed to bring them up to date.

Despite all we say and do, however, there is the disheartening fact that the recorders have not kept to any fixed standard in the past. No one can guarantee that all Decca records, for instance, should be played back on our "Decca" curve. Many EMI records will sound too dull unless played on a curve such as the AES. The main case for a calibrated control unit at the moment is that any solution is better than no solution at all.

I think we must consider both the

past and the future when starting to work out such designs. We must also consider what records are normally available in Australia, and likely to occupy most of our playing time. With these two points in mind, we must count up the number of controls we can reasonably be bothered with, and the number of switch points available on them. Only by such a practical approach will we emerge with an answer likely to be acceptable to all but the really hopeless cases.

TWO STEPS

I don't wish to be misunderstood by that last remark. But I do feel that there are two steps in this business. The hopeless case is a legitimate member of the audio fraternity who gets a great deal of pleasure from experimenting with fine shades of compensation, and there is no reason on earth why he shouldn't be catered for.

Unfortunately, we can't pretend that his control unit is going to be simple or cheap, nor is it going to be easy for the average man to use. The vast majority, I am sure, would be irked by the need to work out knob combinations each time they changed a record.

They will be satisfied with something much less elaborate, and which need not necessarily be unsatisfactory or inflexible.

The great majority of records sold here come through fairly well defined channels. Not many of them are imported using fancy curves, although undeniably there is wide variation to be handled. First of all we must consider that Decca records are very solidly represented and that EMI with its various labels is making a big mark. Both these currently use different curves, but it is not unreasonable to say that our new control must play them both.

Of the remainder, including Westminster, Capitol, &c., the majority appear to be using the AES curve. A few have used the NAB, but beyond that the representation drops away to a comparative dribble. It isn't much use beating our heads about numerous overseas records, which the Americans, for instance, have to consider much more seriously. If we allow that these three present our major problem, then we should, if possible, allocate a switch position to each.

POSITION OF 78's

In fact, we can't allow any more, for the fourth must be set aside for 78's and the fifth for our radio tuner. We can forget the microphone position, as nobody seems to need it.

The 78 position is quite hopeless and we can only see that our unit has extra flexibility in bass and treble controls to build on a standard setting. Many enthusiasts are abandoning 78's altogether, but this, I think, is too severe treatment.

For the future, I believe the tendency will be to adopt one or perhaps two curves as standard playbacks and for companies to use whatever recording compensation they think will make their records sound best with one of them. It is probable that the AES or RCA New Orthophonic will supplant all the others, for even now they differ seriously only in the bass roll-off. In fact, one resistor added to the unit would change the AES into the RCA curve, but as the latter records released here will come through EMI, they will be re-recorded at present to the EMI standards.

The AES curve, too, does very well for most modern 78 records, so that our suggested basic compensation begins to look rather promising.

I believe, however, that today's EMI 78 records are made with a "flat" top end, so that our 78 position should theoretically be correct for them.

OTHER SETTINGS

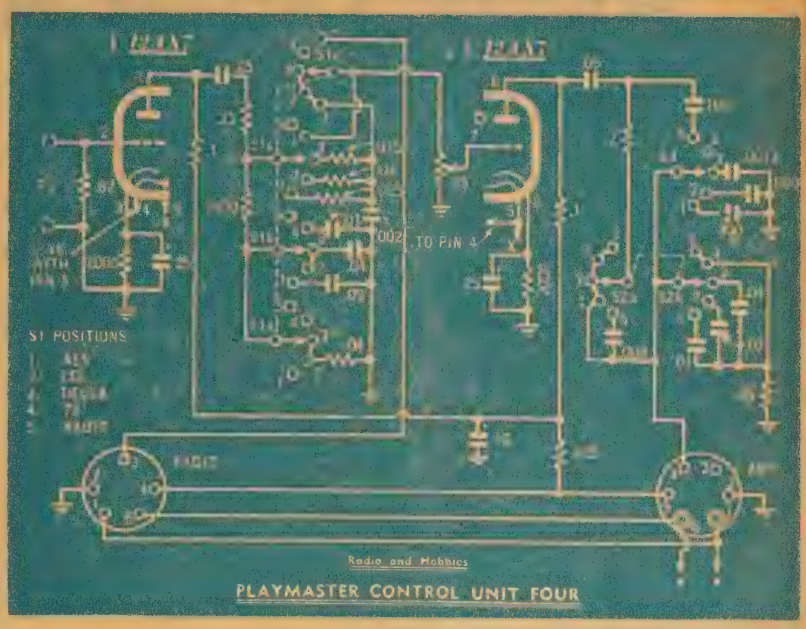
We can even get an almost perfect NAB curve, which is the fourth standard sometimes encountered, by adding one degree of bass boost in our new unit to the EMI curve.

Incidentally, our EMI LP setting compensates for the original American Columbia LP's, and was used for the first HMV, Columbia, &c. Later EMI records used less top cut —about 11 db at 16 Kc. We can effect this change by using our treble boost position which adds another 4 db at 10 Kc. Or we could play them on the Decca setting which is quite close to what we want. Neither process involves much brain power.

It is timely now to consider the extra bass and treble controls, for they are quite important. Experience has shown that only rarely do we desire to cut the bass or boost the treble. If we allow a "flat" position for each control, we can allot three bass boost and treble cut settings, and only one bass cut and treble boost, a much more useful idea than providing "two up and two down". It is also more flexible, as the difference between each step need not be so severe.

I prefer the stepped control under these circumstances to the continuously variable type, in which it is very hard to avoid crowding at each end, or to provide a reliable "flat" position. In fact, to establish some uniform reference in this matter, both controls have been arranged to achieve variations in steps of 4 db up and down referred to 50 cycles and

CIRCUIT OF THE CONTROL UNIT



The circuit of the unit is fairly straightforward and we have grouped the various controls to help make their functions clear. S1a, b, c and d form the selector switch, S2a and b form the extra bass control, and S3 the treble. The 16 mfd condenser can be increased to 32 mfds with extra margin against motor-boating at full bass boost.

PARTS LIST

1 panel 10½ x 3½in with bracket 3¼ x 2½in.
1 case 9½ x 3 x 3½in deep.
1 switch 2-bank 2 x 5.
2 switches single bank 2 x 5.
1 .025 potentiometer.
1 12AX7 valve.
Sockets: 1 Noval, 1 6-pin, 1 5-pin.
Resistors ½ watt 5%: 1 .33 megs, 1 .2 megs, 2 .04 megs, 1 .05 megs, 1 .025 megs, 1 .015 megs, 1 7500 ohms.
Resistors ½ watt: 2 .1 megs, 1 .025 megs, 1 .02 megs, 2 2000 ohms.
Condensers 200 volt 10%: 2 .04 mfd, 1 .02 mfd, 1 .01 mfd, 1 .0013 mfd, 1 .05 mfd, 1 .0003 mfd, 1 .07 mfd, 1 .008 mfd, 1 .0008 mfd, 1 .002 mfd, 1 100pf.
Other Condensers: 1 16 or 32 mfds, 350 pv, 2 25 mfds, 2 .05 mfds, 350 volt working.
Panel light on bezel if required, 4 1½in knobs, 2 8-terminal tag strips, engraved front panel, hookup wire, 3 countersunk bolts and nuts, etc.

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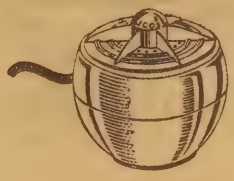

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TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.3-2	General Purpose	1¾in dia. x ⅜in thick	20db Peak at 2500 C.P.S.	Mona	£1 19 3
MIC.3-5	„ „	„ „ „ „ „	12db „ „ „ „	Mervyn	1 19 3
MIC.3-6	„ „	„ „ „ „ „	5db „ „ „ „	Myrtle	1 19 3

MIC. 6 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.6-4	General Purpose	2 1-32in dia. x 19-32 thick	20db Peak at 2250 C.P.S.	Margie	£1 19 3
MIC.6-6	„ „	„ „ „ „ „	5db „ „ „ „	Maudie	1 19 3
MIC.6-11	„ „	„ „ „ „ „	12db „ „ „ „	Mandy	1 19 3

MIC. 14 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.14-5	General Purpose	1 7-16in dia. x 11-32in thick	20db Peak at 3500 C.P.S.	Maxie	£1 19 6
MIC.14-11	„ „	„ „ „ „ „	12db „ „ „ „	Mitchell	1 19 6
MIC.14-12	„ „	„ „ „ „ „	5db „ „ „ „	Malcolm	1 19 6
MIC.15	Hearing Aid	0.9in dia. x 0.155in thick	30db „ „ 3000 „	Marlene	1 19 6
MIC.17	„ „	15-16 in sq. x 7-32in thick	30db „ „ 3500 „	Maggie	1 19 6
MIC.18	General Purpose	1 7-16 in dia. x 9-32in thick	20db „ „ „ „	Maisie	1 19 6

MIC. 23 SERIES

TYPE	DESCRIPTION	DIMENSIONS	RESPONSE	CODE	PRICE
MIC.23	General Purpose	1 3-16 sq. x ¼in thick	20db Peak at 3000 C.P.S.	Maureen	£1 19 3
MIC.23-3	„ „	„ „ „ „ „	5db „ „ „ „	Margaret	1 19 3
MIC.23-4	„ „	„ „ „ „ „	12db „ „ „ „	Milton	1 19 3
MIC.32	High Quality	1 13-16 dia. x 9-16in thick		Martin	2 15 6

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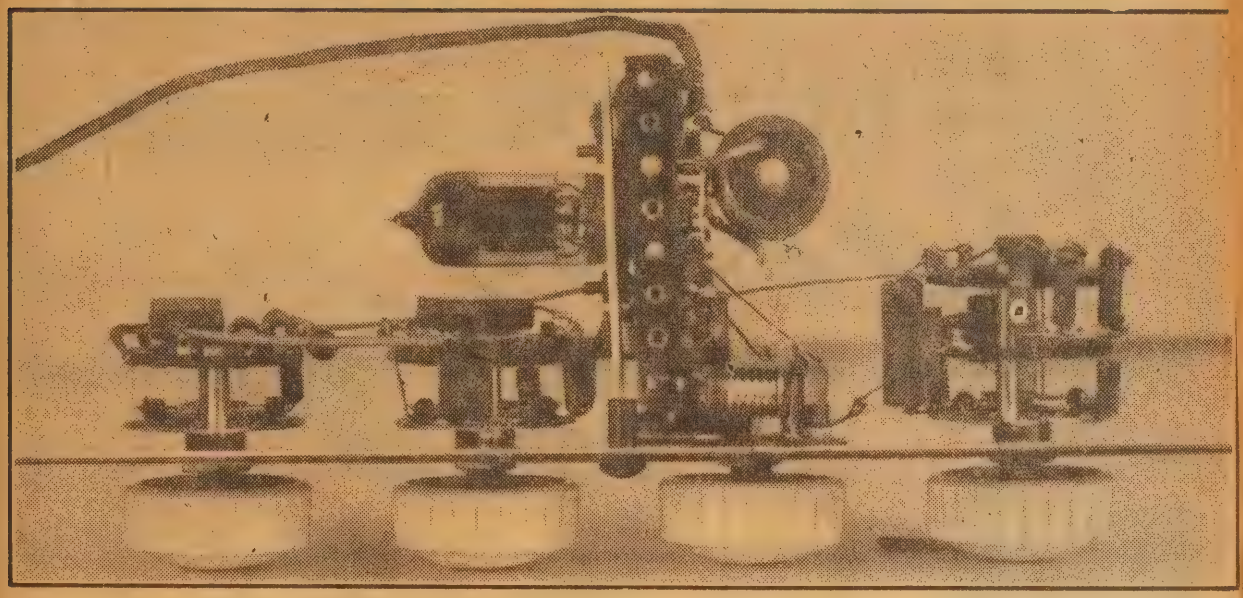


Note how the small components are mounted across the switch wafers. The three resistors and baby condenser on the selector switch at the right are in the treble cut circuit. Bass boost condensers are on the left of the switch. Odd condenser values may be made by paralleling standard values if necessary. The shielded lead runs to the pickup through the rear of the case.

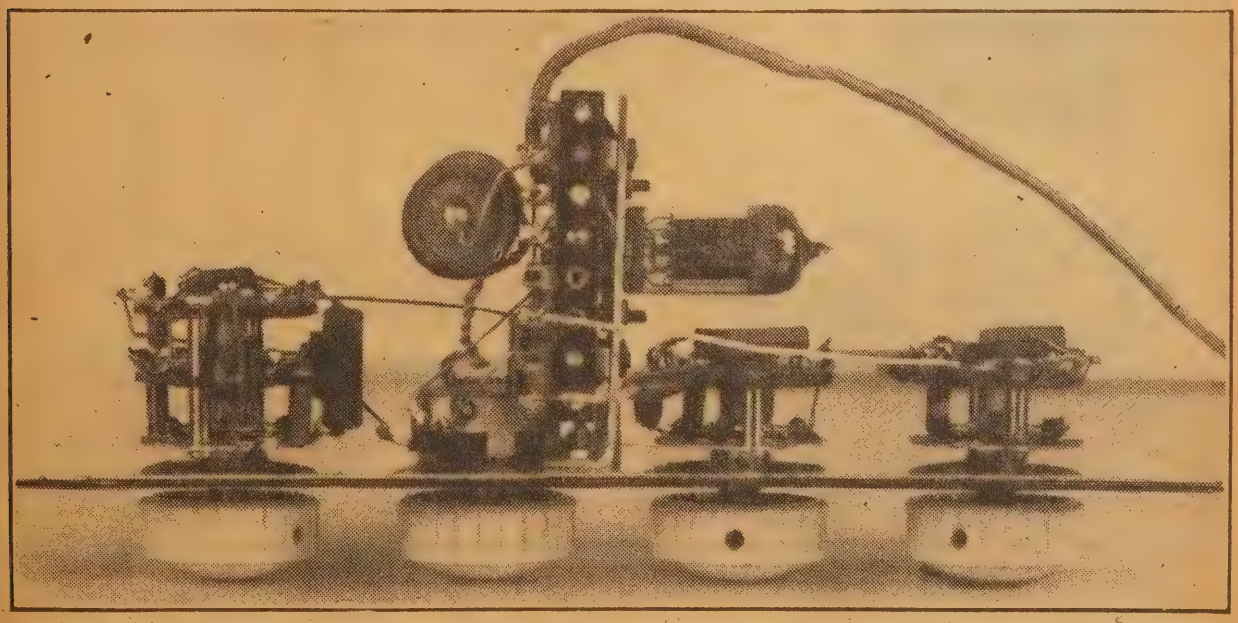
10kc. Smaller increments than this are rarely required, and if we want to play around with curves, we do know by how much we have added or subtracted to a known value.

Do we want to boost only the extreme ends of the scale, or do we want a gradual change starting from about 1 Kc for these extra controls? If we use them mainly to compensate for changes in volume, the Fletcher-Munson curves indicate that a gradual change is needed, centred at about 2 Kc. If we want to compensate for room effects, your guess is as good as mine. We have kept to the simple method, allowing both boost and cut to continue without any roll-off other than that provided by the voltage divider constants, and it has worked out very well. Without a much more clearly-defined requirement, I don't feel that any more elaborate system is warranted.

The treble cut is likely to be most useful for 78 records if we play them on the 78 position and cut the top until the records sound best. There are no treble "roll-off" filters provided, not only because they are extremely complex if they are to work well (and I haven't yet seen one which lives fully up to its name), but because I personally am not satisfied they are worthwhile. Certainly not in a simplified unit such as this.

So much for the basic idea behind the new control unit. From the practical angle it uses the same switches as the old No. 2, many of the same parts, a single valve of a higher gain type, and although we have made No. 4 slightly smaller, the old metalwork will still be OK, for the layout is substantially the same.

Does this sound something like a reasonable solution to today's requirements? I think it does, and so do quite a few of my friends whose



Another view of the unit from the opposite side. These two pictures show the position of nearly all components. Connections are made from the 5 and 6-pin sockets on the case to the appropriate lugs on the terminal strips. They are made just long enough to solder in place before finally bolting the case to the panel.

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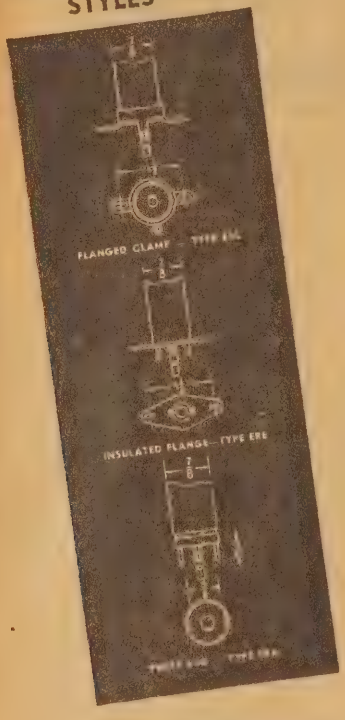

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2000	2½	4	2½	¾	20	150	200	1⅝	⅜
100	10	12	1⅛	½	8	300	350	1⅝	⅜
250	10	12	1⅝	⅜	16	300	350	1⅝	⅜
400	10	12	1⅝	⅜	24	300	350	2½	⅜
500	10	12	2	⅜	16	350	415	2	⅜
10	25	40	1⅛	½	8	450	525	1⅝	⅜
25	25	40	1⅛	½	16	450	525	2½	⅜
100	25	40	1⅝	⅜	8	500	600	1⅝	⅜
50	125	150	2	⅜	16	500	600	2½	⅜

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advice I have asked. It is interesting, too, to note a similar tendency in quite high-grade units now being made overseas. It's not really remarkable, because it had to happen.

The circuit of Control Unit Four is basically the same as the No. 2 in that it uses a voltage divider system of compensation. The average man finds it much easier to understand than the inverse feedback method often used. The latter undeniably will have less distortion, but the input and output voltages to be handled are so low as compared with the valve's handling capacity that distortion is negligible in any case.

INPUT VOLTAGE

The input required for full output is only 40 millivolts, a mere fraction of the permissible grid swing. The second section of the valve handles very little more, for the loss in the main compensation network is about 35 db. The main amplifier needs only about 350 millivolts for full output, and the 12AX7 can deliver about 50 volts with about 5 pc distortion. As the distortion is less than a direct proportion to the output voltage, we are not likely to be worried over differences which are somewhat microscopic.

The circuit constants used in the initial compensator are based on those worked out by C. P. Boegli, a research engineer whose work is accepted as more or less standard in this field. We can thank him for saving us many hours of calculation and test, although it has taken quite a while to check on the final curves and make a few modifications to suit our needs.

If you compare our measured curves with the standards shown in Neville's article, you will see how closely theory and practice can be made to coincide!

Reasonably close tolerances are needed for exact results, and 5 pc resistors and 10 pc condensers should be used. We are trying to arrange for these to be available perhaps as kits from our advertisers, but in any case you should not find them very hard to obtain.

The second compensator divider network is simpler, and has much lower loss than the first. But, apart from the separation of the switches, it is quite similar.

The big loss in gain required to obtain the full degree of initial compensation calls for a higher gain valve than the ECC33. The 12AX7 has been used, although the 6SL7 would give substantially the same results. Neither the 12AT7 or the 12AU7 can be used without reducing the input sensitivity to about 100 millivolts and 600 millivolts respectively, which may not be enough except for crystal pickups.

VOLUME CONTROL

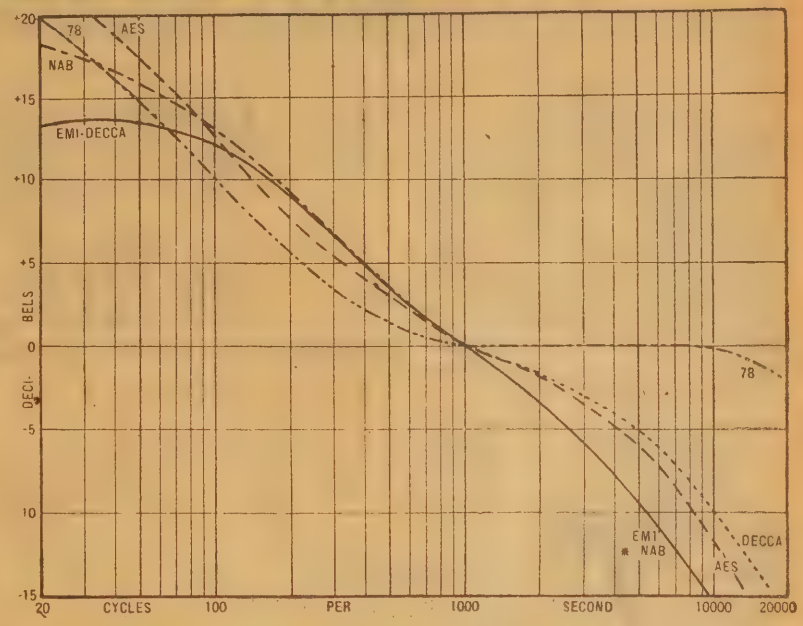
Of particular importance is the .25 meg volume control value. High-gain triodes are particularly susceptible to Miller effect and its resultant high-note loss. With a 1 meg control there will be a drop of 6 db at 10 Kc with the gain set for half output, under which conditions the grid is isolated from either end by .5 megs. The recommended value limits this maximum loss to about 1.5 db, which is not serious. Nor does the lower grid impedance unduly affect the bass roll-off of the compensator above 30 cycles. There isn't much to be heard in that region anyhow except motor rumble and other unwanted noises.

The output circuit to the amplifier is at quite low impedance above 1 Kc—about 50.000 ohms. This renders the shielded cable to the amplifier non-critical as to high-note loss through Miller effect. Ordinary shielded braid can be used, although a length of co-axial cable is to be preferred because of its much lower capacitance.

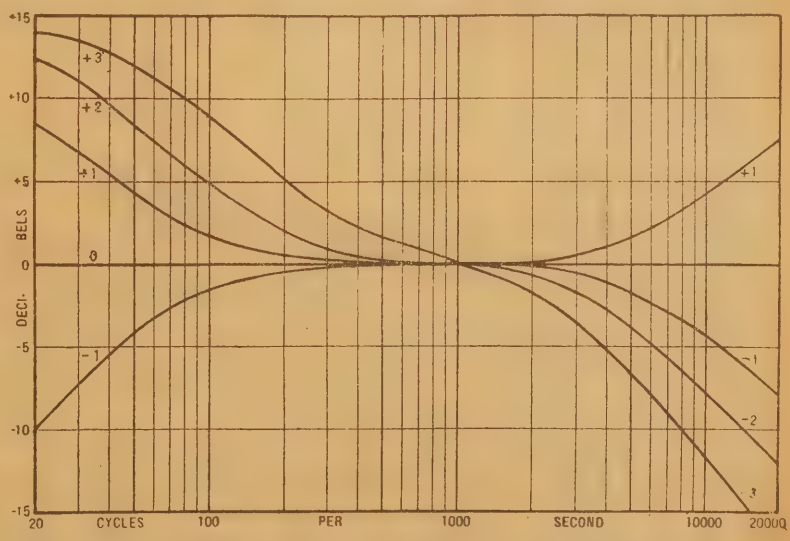
This low impedance connection also renders the cable and circuit generally less susceptible to hum pickup, and is an improvement on the No. 2 unit in this respect.

Our elevation photograph of the unit shows that each switch and the valve-mounting bracket may be wired as self-contained units with the necessary connecting wires. The miniature resistors and condensers are mounted between decks, earth points being made to the switch frames and to appropriate lugs on the bracket terminal strips. Theoretically one-point earthing for each

RESPONSE CURVES OF THE UNIT



These are the actual response curves of the selector switch positions taken through the unit and the Playmaster Seven as described on pages 28-35. Note how closely they agree with those on page 73.



These curves taken under the same conditions as those in the top diagram show how the extra bass and treble controls are arranged in 4 db steps measured at 50 cycles and 10 kc.

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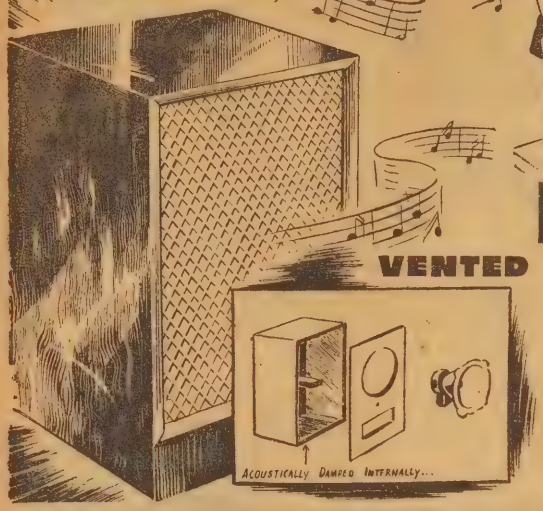

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896-9	8000 10,000	2, 3.7, 8, 12.5, 15	1	30-15,000	15	PP 6V6G's A OR ABI TO VC	62/6
897-9	8000 10,000	100, 125, 166, 250, 500	1	30-15,000	15	PP 6V6G's A OR ABI TO LINE	62/6
763-9	3000, 5000	2, 3.7, 8, 12.5, 15	1	40-20,000	15	PP 2A3's A OR ABI TO VC	62/6
809-26	500	2, 3.7, 8, 12.5, 15	1	50-20,000	15	LINE TO VOICE COIL	42/6
870-26	10,000	2 or 8	1	*20-20,000	6**	PP 6V6G's OR 807's AS TRIODES	57/6
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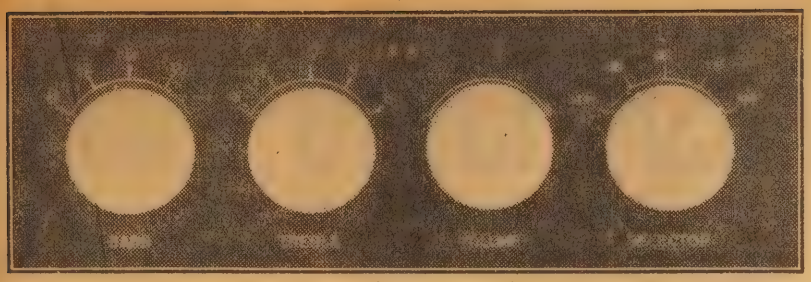


A picture of the front panel.

circuit would be best, but it enormously complicates construction, and we cannot detect any appreciable hum voltages due to the direct earthing method. There are no AC currents flowing in the unit, as the filament circuit is earthed only in the main amplifier itself.

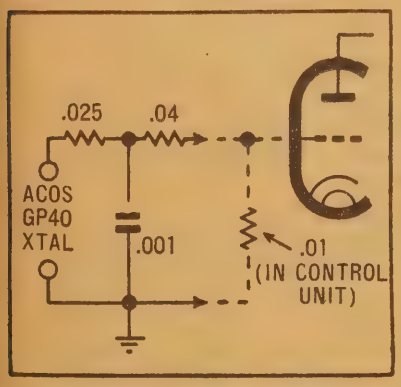
The accompanying diagram shows how we mounted our components on the valve bracket, and no description will be given here.

The amplifier connects via a 6-pin socket at the back of the cover for the unit, and the radio tuner to a 5-pin socket. The filament, high tension and earth connections between these two sockets are made by separate wires, and the unit is earthed by a lead from the 6-pin socket to an earthed lug on the valve bracket. This avoids a possible loop which might be formed by using the unit's cover and mounting bolts as an earth connection to the panel assembly.

PANEL LIGHT

The panel light is a refinement, and uses one of the little plastic bezels now available which may be merely glued or "push fitted" into a hole drilled through the panel. Under no circumstances must the lampholder allow either side of the filament supply to be earthed.

The input circuit of the unit must be considered in relation to the pick-up which feeds it. Unless this has a flat response, the compensation curves will not be accurate, so that we would be wise to use as good a pickup as possible. There are several very good lightweight mag-



Compensating pad to be used with the HGP39 pick-up. The .02 meg grid resistor in the unit must be changed to .01 as shown here.

netics suitable for modern records available, the best of which vary only a decibel up or down and have resonance peaks if any tucked well out of the way.

Most of these will work well into .02 ohms as specified, but if the makers suggest another value, then by all means use it.

With pickups having an output below about 40 millivolts, transformers are often used, and these should not be shunted with a resistance at all unless the markers advise it. If they don't, include a 2 meg grid leak to ensure some grid return if the pickup should become disconnected.

SPECIAL PICKUPS

Several special moving coil pickups can be had from overseas, and these generally have very low output and a coupling transformer. Most transformers step up the output voltage to around about 100 millivolts—ample to drive the unit.

We have even played a variable reluctance pickup straight into the unit with quite good volume, although not enough to reach full output.

Crystal pickups are more difficult as even the best don't seem to give a smooth output. The main type likely to be of interest in the quality field is the new HGP 39, and we show here a compensating pad which reduces its output to about 50 millivolts to avoid overloading the first valve, and at the same time flattens its output. It is still a bit bumpy from 7-11 Kc and the values are for the only head available at the moment, but the pad is simple to make and the pickup should not be used without it. The .02 resistor must be altered in value to .01, as it becomes part of the network. We intend to do some work with crystal pickups along these lines, as we know that many will use them with the Playmaster.

FINAL CHECK

As a final check on all this work, a test was made to test the performance of the control unit in conjunction with the Playmaster Seven described in this issue. The pick-up was a Super Lightweight Connoisseur, which we mention purely for purposes of record, and the test record by Decca cut to the same curve as that for which the unit was designed. It should be mentioned that the original circuit constants were worked out and adjusted on the input from an audio oscillator, and were not disturbed in any way during the test, nor were they previously checked using the record.

The pick-up was operated into a 3000 ohm load, this being the value found to give the flattest response, and which varied from the recommended value of 1000 ohms for the 400 ohm head. The stylus was a sapphire which had previously played about 25 discs, this being regarded as something of

(Continued on Page 111)

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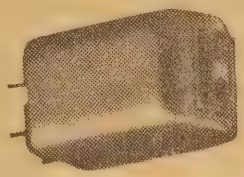

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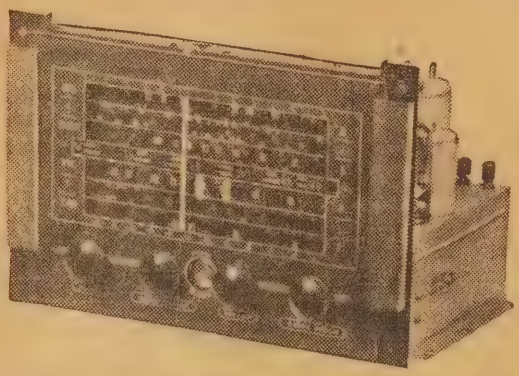

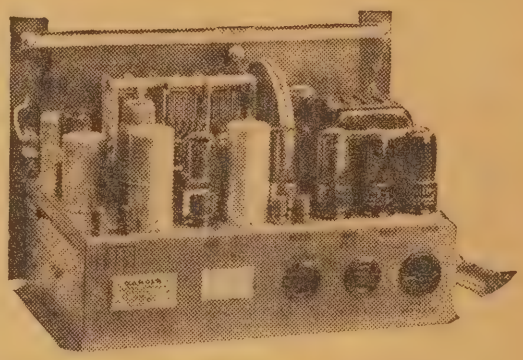

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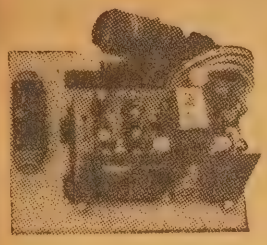

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Highly powerful. New. Large U Magnets. From Radar equipment. Weight 13½lb. Suitable for industrial separators, etc.
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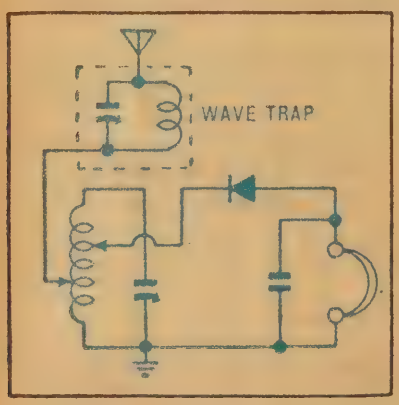
Here's your answer, Tom!

Occasionally we get letters from readers accusing us of including parts in our designs which are not strictly necessary. Apparently, there is a suspicion that we are in league with the parts manufacturers to cheat the unsuspecting homebuilder, but you can take our word for it that there is always an excellent reason for every part included, even though it may not be immediately apparent.

TOM'S first question this month is an example from a recent letter.

Why does the Radio and Hobbies battery charger employ a 1 ohm resistor in series with the transformer secondary winding? Surely, this resistor would dissipate power and therefore make the charger draw extra current from the power mains.

Yes Tom, the resistor does dissipate power that does not do anything toward charging the battery but there is a very definite reason for including it. We will explain.



A wave-trap circuit

For the purposes of the discussion, the charger can be regarded as a little black box which behaves like a battery with a resistor in series with it.

The voltage of this hypothetical battery is determined by the number of turns on the secondary winding of the transformer. The resistance of the hypothetical resistor depends on that of the transformer winding and the characteristics of the metal rectifier.

With a particular rectifier and transformer, let us say that the battery could be regarded as having a potential of 12 volts and the resistance 1 ohm.

Now, say we wish to charge a 6 volt accumulator which has been fully discharged and has a potential of only 5.5 volts. We connect this positive terminal of the charger to the positive terminal of the battery. Likewise the negative terminals are connected together. Since the battery in the "little black box" has a higher potential than the battery required to be charged, current will flow in the desired direction.

Its value can be calculated from Ohm's Law. The effective potential driving current around the circuit is the difference between the two potentials and the resistance in the circuit is the sum of the internal resistances of the charger and the battery.

In a typical case, the internal resistance of the battery will be of the order of .005 ohms which is so low in comparison with that of the charger that we can neglect it for the purposes of the argument.

RESULTING CURRENT

The effective driving potential is therefore 6.5 volts and the resistance 1 ohm. The current will therefore be 6.5 amps.

Later, when the battery is approaching full charge it may have a potential of up to 7.5 volts in which case the circuit current will be 4.5 amps. The charging current has changed by 2 amps during the charge.

If, as we have done in the R & H charger a 1 ohm resistor is placed in series with the circuit making up a total resistance of 2 ohms, the current will be 3.25 amps with the battery fully discharged and 2.25 amps as the battery approaches full charge.

Note that the difference between the charging currents at the ends of the charge is only 1 amp in this case. And so it goes.. The higher the internal resistance of the charger, the smaller will be the change in current with the change in the potential of the cell under charge.

You certainly would not wish to carry the idea to extremes because the amount of energy dissipated in the resistance compared with that usefully employed in charging the battery would be too great.

RECTIFIER RATING

In our case the maximum charging current is limited to 3 amps by the specifications of the rectifier. This is not a large amount of current as chargers go, even for small batteries and it is desired to keep it as high as possible so that the battery can be charged in a reasonable time.

If the resistor had been omitted and the transformer voltage adjusted for 3 amps charge at the beginning, the current would have dropped to about 1 amp at the end and the charging time greatly increased.

Because it tends to hold the current steady, the additional series resistor is often referred to as a "ballast" resistor.

I have just completed a crystal set but I find that a local station tends to "blot" out another station which I can hear between programs on the local station. Could you suggest a remedy for this?

We can suggest something for you to try, Tom, but we can't guarantee your money back if it doesn't work. The difficulty is to design a crystal set which will make efficient use of the signal received by the aerial and at the same time be able to separate signals which are close together in terms of frequency.

In practice, it may be cheaper to make a set with several valves in it than to make the tuned circuit with the required performance.

We suggest however, that you try a wave trap in series with the aerial lead. The wave trap consists of a coil and tuning capacitor, both of which can conveniently be the same as used in the set already.

If I plugged in to DC?

Connect the coil and the capacito in parallel. Then, connect the aeria to one junction of coil and capaci tor and the aerial terminal of th set to the other. When installed i this way the circuit behaves as rejector, tending to reject the sta tion to which it is tuned.

Therefore you adjust the wav trap for minimum volume from th interfering station and the norma tuning control for maximum volum from the desired station.

The trap may cause some drop i

the volume of stations, even though it is not tuned close to them and it may therefore be desirable to remove it from the circuit altogether on some occasions. This can be accomplished conveniently by bending one of the rotor plates of the variable capacitor so that it shorts the capacitor with the plates fully in mesh.

Note particularly, that it will probably be necessary to mount the tuning capacitor for the wave trap on a piece of insulating material because the rotor plates are usually connected to the frame.

On the back of my radio is a notice stating that the instrument is designed to operate on 240v 40 to 60 cycles alternating current only. What would happen if I plugged it into direct current power mains?

According to legend, Tom, a picture is worth a thousand words. Our artist has produced a good thousand words worth.

Most receivers designed to operate from AC employ a power transformer. The primary winding has a large number of turns of fine wire and is wound around the iron core so that it has considerable inductance—the property which resists a changing in the flow of current. Alternating current is always changing so that its flow is appropriately impeded.

STEADY FLOW

However, direct current flows steadily always in the same direction and the only quality to impede its flow is the resistance of the wire. This would be the same if the wire were stretched out in one straight run and is comparatively low.

The result is that a large amount of current flows and a large amount of power is dissipated in the form of heat. Hence the results.

Further, the transformer depends on the alternating current for its action so that no power is passed on to the set itself.

If you want your set to operate from DC it would be necessary to carry out extensive modifications. We would have to know more about the set to say for sure, but it is likely that it would be cheaper to trade it in and buy one specially designed for the job.

How can I calculate the total current drain of a receiver in order to determine the rating of a power transformer to be used with it?

Your best plan would be to obtain a valve data book and look up the characteristics of the various types in the set. Usually a set of typical operating conditions is included as well as the maximum ratings.

It is then simply a matter of adding up the separate currents in order to determine the total.

The difficulty comes if the valves are operating under non-standard conditions. For example, it is a common practice with output valves in small sets to operate with greater than the usual amount of bias in order to lower the current drain. The power output is lower, of course, but frequently there is a reserve of power, anyway, so that this does not matter.

Provided the conditions are not markedly different from the standard, you will be able to arrive at a fairly accurate result by scaling down the current in simple proportion. Radical changes will make it necessary to use the plate current curves which are provided for most output valves. The problem can become somewhat sticky when you do not know either the current drain or the applied bias and for some cases it would take a long time to arrive at a solution.

The current of the output valve is usually high compared with the current drawn by the other valves and, therefore, it is important that you determine its current accurately if you want an accurate overall result.

On the other hand, the total current drain of the audio voltage amplifier stage is only a milliamp or two and it would not affect the overall result very much even if you made a 50 pc error.

In some of your designs the electrostatic shield of the power transformer is earthed and not in others. Doesn't a transformer always have an electrostatic shield or is it not always essential that this be earthed?

Practically all transformers made for radio work are fitted with a electrostatic shield and this shiel should be connected to the chassi of the equipment.

We must plead guilty to charge of having left out the electrostati shield in some of our schematic diagrams in cases where the shields were actually present. Most constructors know that the shield should be earthed but we will try to show it on the diagrams in future so that there will be no doubt.

MODULATION HUM

If the shield is not earthed, there is a possibility of "modulation hum" being introduced. It only appears when the set is tuned to a station. The tendency for clicks, thumps and various line noises to get through to the receiver output is also greater when the shield is not earthed.

There are some cases when there is not a great deal of point in the shield and the manufacturers usually omit it. Such a case would be a battery charger, where no sensitive radio frequency device is involved. You will be able to think of others.

Is there any advantage in using fixed bias instead of cathode bias?

Both yes and no, Tom. Cathode

(Continued on Page 106)

How flat cells give a portable radio

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Let's Buy An Argument

Have you ever read a novel or seen a picture with an unhappy, inconclusive kind of ending? For all its possible interest, it leaves you with a sense of frustration. That's just about the feeling you get after spending a few hours poring over record compensation curves.

by Neville Williams

BY "record compensation curves" I mean, of course, those which purport to show the amount of treble boost and bass cut which various manufacturers incorporate in their records. And, of course, I refer by inference to the inverse amount of cut and boost which should operate in the amplifier when playing back the said records.

As one pores over the relevant information, observes the multiplicity of "standards", the many discrepancies and the scope for variations and "accidents", the first impression is one of utter futility.

Or perhaps I'm just a morbid type.

OTHERS ALSO

However, it is quite obvious that others have felt the same way, as evidenced by our mail and by discussions we've had on the subject. Just recently, for example, an engineer from a broadcasting station called in for a chat about things, with a bundle of curves under his arm and a very worried look on his face.

Some take the easy way out. They shrug their shoulders, spread their hands, cock their head to one side, raise their eyebrows and add — if words are necessary—"What's the use?"

They settle for some "average" degree of compensation and rely on wiggling the tone control (or controls) to make the end result sound acceptable, if it isn't so in the first place.

At the other extreme, one finds the hardy souls who dig out all kinds of obscure information about the habits of recording companies. They come up with compensating circuits that must make the component manufacturers jump for joy.

And, in between (bless their hearts), are the more average types who are prepared to compromise. But what complexity is bound up in that one simple word!

I've been planning to review the situation in these columns for some time. My reason for doing so in this particular issue stems from some earnest discussions with the Editor about the desirability or otherwise of revamping the "Playmaster" control units.

THE PROBLEM?

Since you have to state a problem before you can find a solution to it, we decided to co-operate. (One happy family and all that!) I would analyse the requirements, he would try to meet them! How successful or otherwise he has been, you can judge for yourself.

After all, the Editor is well able to tell his own story! (That's how you get to be an editor.)

But to get down to facts, the need for some kind of recording law is generally conceded. By restricting the natural rise in amplitude at the bass end, closer groove spacing can be achieved with a substantial increase in record playing time.

And, at the treble end, by boosting during recording and cutting during playback, a significant improvement can be obtained in the signal/noise ratio.

So far, so good. But the obvious question follows . . . By how much should the bass be restricted by the makers and the treble be pre-emphasised?

A lot of bass cut means a lot of bass boost during playback, added demands on the amplifier and a greater danger of amplifying motor rumble to a prohibitive degree.

TREBLE TROUBLE!

And too much treble boost during recording produces sharply angled grooves, which ordinary pickups find it very difficult to track.

No matter how proud an engineer may be of his ability to achieve long play, low noise and brilliant treble, it is cold comfort if the public, using mediocre equipment, judges his records as 'too thin, too rumbly or too subject to wear".

It's all very much a matter of compromise and, as one might imagine the ideas of engineers in different companies and countries and over the years have shown wide divergence.

Because of so much recent discussion, some readers seem to have

the impression that the confusion over recording laws is largely a heritage of the microgroove record. Actually this is a long way from the truth, microgroove records being actually much more uniform in their characteristics than the 78's.

I must admit that the full force of this statement had not registered itself on me until I actually started to dig out the relevant information and superimpose the curves. You can see the result of our efforts in figure 1.

The curves have been drawn in such a way that they are complementary to the various recording characteristics and therefore represent the idealised amplifier response.

One can immediately recognise the traditional EMI-cum-European characteristic, with its level top response and an approximate rise of 6db/octave below 250 cps.

Then there is the Decca ffrr characteristic, requiring a little less bass boost and a small amount of treble cut. (Some apparent confusion surrounds this curve in published literature.)

AMERICAN RECORDS

As for American records, everyone's known in a loose kind of way that they need more bass boost and, as a rule, a certain amount of treble cut when playing back.

But I wonder how many, outside the "sleuths", have realised that American 78's have been recorded with varying degrees of bass cut and with treble boost up to the most extreme microgroove characteristics?

The curves shown in figure 1 are not likely to be complete but they do indicate probable limits. Just how many other variations or combinations there may have been—official or otherwise—goodness only knows!

Sufficient to say that the limits are much wider than those for the microgrooves, and a lot of frantic dickering with tone controls in the past is doubtless attributable to this fact.

Actually, there is little point now in laboring the 78 rpm position, because the popularity of these records for other than "pop" music has greatly diminished.

And what is no less important, the vast majority of 78 rpm records sold to date in this country have employed the more conservative standards, so that we have less occasion to be concerned about the question than our friends across the water.

Perhaps I'm inviting trouble by dismissing the 78's so lightly but I intend to do so just the same.

A LESSON?

One might have hoped that, having observed the confusion reigning in the 78 field, manufacturers would have agreed on some universal equalisation standard for the microgrooves.

However, such secrecy and such bitter rivalry surrounded the launching of the finer grooves, that we must count ourselves lucky to have come off with a standard stylus!

Perhaps we are fortunate, too, that technical necessity led to the adoption of recording laws that do at least bear some resemblance one to the other. They all involve a considerable degree of treble pre-emphasis and impose a considerable restriction on the bass response.

This means that the ordinary run-of-the-mill radiogram can be designed to play microgrooves with some 15db of bass boost and enough treble cut to level off the top end.

As often as not, this involves nothing more complex than using a well damped crystal pickup into a high resistance load and feeding its output past a tone control into an ordinary speaker.

Let it be said, in all fairness, that the result can be quite pleasant to listen to, provided one doesn't try to analyse the musical content too closely.

In point of fact, if one's approach is on the level of the ordinary radiogram, it is largely futile to worry about the discrepancy in recording curves.

An ordinary pickup and an ordinary speaker will impose very serious limitations on the overall response, as well as local troughs and peaks up 5 or 6 db. To be concerned, in the face of that, with lesser variations, is plainly futile.

One can't logically begin to quibble about microgroove standards until the playback equipment is sensibly flat from stylus point to speaker output and the listener sufficiently keen and informed to be aware of possible variations.

If this last statement is true (and I've made it), it automatically narrows down the number of legitimate "standards quibblers" to a small percentage of the total record buying public; to the informed "audiophiles" whose equipment includes at the very least a good magnetic or the best of crystal pickups, a good amplifier and a wide-range speaker system.

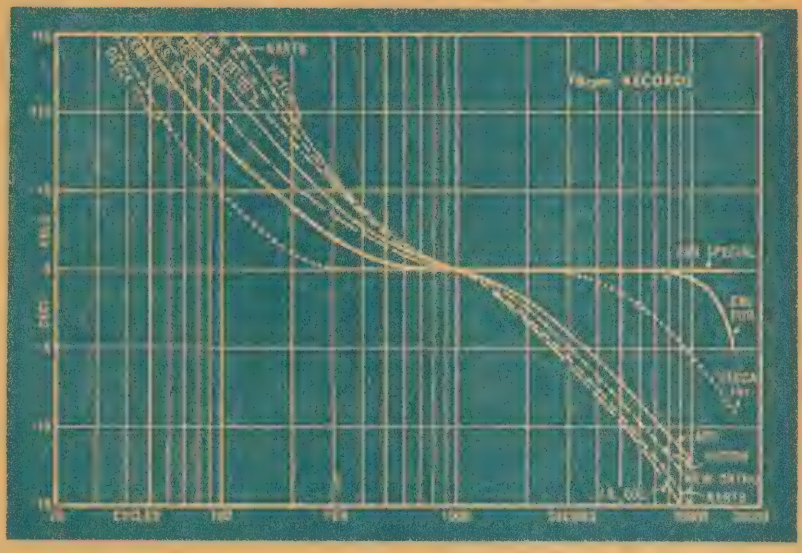
OTHER HAZARDS

Even then, it might be argued that variations in stylus fit, pickup response, speaker output and room acoustics will be responsible for greater deviations from "level" than those revealed by standards curves.

This may be so but, as long as the response is good enough to be accepted as wide-range by the critical listener, and as long as the listener can notice variations from his own accepted standard, then a case can be made for more accurate equalisation.

Having thus narrowed down the field to those who can legitimately argue about standards, the next point

CONFUSION OF 78 STANDARDS



For a picture of real confusion, one need turn only to the 78 record field. Here are a few of the "standards" copied from published information. All these have been used at various times, together with a never-ending variety of variations and combinations.

78 STANDARDS

The curves shown above have been used, as follows, by the major recording companies:

EMI-EUR: EMI group; most early European records; most Australian; some American. (Where not abandoned altogether, the tendency has been to modify this standard by increasing the bass turnover frequency and/or using a small degree of treble boost).

DECCA FFRR: English Decca ffrr (where so marked); London.

VICTOR: Victor and other RCA pressings from 1938 to about 1949. (In some cases the response was cut sharply at 9kc to minimise distortion.)

NAB: Principally MGM and Capitol.

AES: American Decca, Capitol, Capitol-Cetra.

US COL: American Columbia and allied pressings.

NEW ORTHO: Victor and other RCA pressings since about 1949.

BRÜEL & KJÆR

Electrical engineers

OF COPENHAGEN, DENMARK

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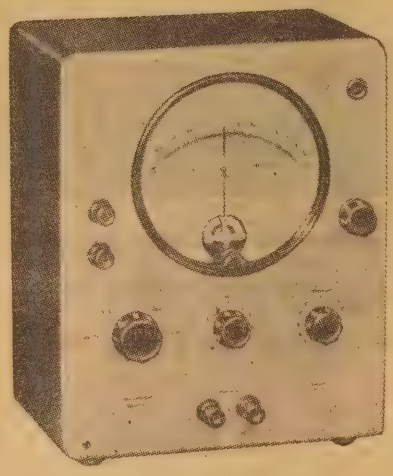

INSTRUMENTS FOR COMPONENT TESTING

DEVIATION TEST BRIDGE
Type 1502 and 1507

has been designed for use primarily in the production inspection of resistors, capacitors, and inductors. Operationally, the percentage of deviation of the component to be tested from a standard component is read on a large illuminated scale. The scale itself has two ranges. The indicating meter is of the moving coil type and is equipped with a specially constructed pointer to aid in reading. The Deviation Test Bridges have a very high indicating speed, making it possible to test as many as 4,000 resistors or 2,000 transformers per hour. The range calibration and the zero adjustment are readily performed by means of a built-in standard. The stability of these units is very high and readjustment of the standard controls is generally necessary only once a day.

SPECIFICATIONS

MEASURING OBJECTS FOR DEVIATION MEASUREMENTS	TYPE 1502	TYPE 1507
Resistance	10 Ω-10 MΩ	20 Ω-100 kΩ
Capacitance	50 pF-10 μF	25 pF-0.1 μF
Inductance	2 mH-100 H	100 μH-0.3H
MEASURING OBJECTS FOR DIRECT READING WITH EXTERNAL STANDARDS		
Resistance range from	0-0.7 Ω to 0-3.3 MΩ	
Capacitance ranges from	0-7 pF to 0-3.3 μF	0-7 pF to 33 μF
Measurement Frequency	1000 c/s	50 kc/s

INSTRUMENT: Large moving-coil instrument and illuminated scale with zero point in the centre. The instrument is safeguarded against overloads. Full scale deflection from — 7% to + 8% on one range, and — 25% to + 35% on the other range.

COMPARISON ACCURACY: Better than 0.1% at zero point.

TOLERANCE ACCURACY: Better than 5% at full scale deflection.

SPEED OF OPERATION: Normal production test is 4,000 resistors or capacitors per hour.

STABILITY: The zero point is independent of the line voltage.

AC-HUM: The bridge is not sensitive to hum voltages.

TUBES: 3x6AU6, 6AQ5, 6X4, OA2, and in Type 1507 also 6AL5.

POWER SUPPLY: 115, 127, 150, 220 volts a.c. 40-120 c/s. 40 watts.

DIMENSIONS: 33 (height) x 28 (width) x 20 (depth excl. dials) centimeters.

13 (height) x 11 (width) x 8 (depth excl. dials) inches.

WEIGHT: 9 kg or 20 lbs.

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is to discover what order of variation we are likely to be concerned with.

Let me begin by saying that I can find nothing to justify the idea that a very large selection of networks must be provided, capable of equalising every possible curve to within a fraction of a decibel.

It isn't enough to accept on face value names like "AES", "NARTB", "New Ortho" and so on. Impressive as they may sound, the real point of the matter is whether such names describe variations in frequency response WHICH THE EAR CAN ACTUALLY APPRECIATE.

One interested party I know claims to have identified no less than 24 such "standards". Crowded into the likely space on a graph, the curves would have to lie only a fraction of a decibel apart.

NOT THAT GOOD

And good though trained ears might be, they just can't appreciate fractions of a decibel. It would be difficult indeed to make a case for twenty four degrees of compensation, even if one had the records which used them!

In point of fact, details of microphone type and placement, the tolerance in tape machines, in cutters and equalisers, and the exigencies of record stamping will all combine to prevent the manufacturer from achieving his own ideal figures.

It's one thing to set and publish standards. It's another thing altogether to keep them in production.

After that, the record still has to run the gauntlet of a reproducing chain, which will impose further arbitrary variations, beginning with the stylus point and ending with the state of the listener's ears.

I just can't believe that all this can happen with enough precision to warrant fussing over an odd decibel.

The best we can possibly do is to apply what seems to be a sensible amount of compensation to each disc and hope that "factors beyond our control" do not render the whole operation rather futile.

But I must say that the standards position itself is highly confused, even without the "factors beyond our control".

Viewed in a textbook or on a data sheet, the curves used by the various manufacturers look all very neat and official. Unfortunately, however, when one sets out to compare and re-plot them, it becomes obvious that they have been drawn by mere man.

EVEN GUESSWORK

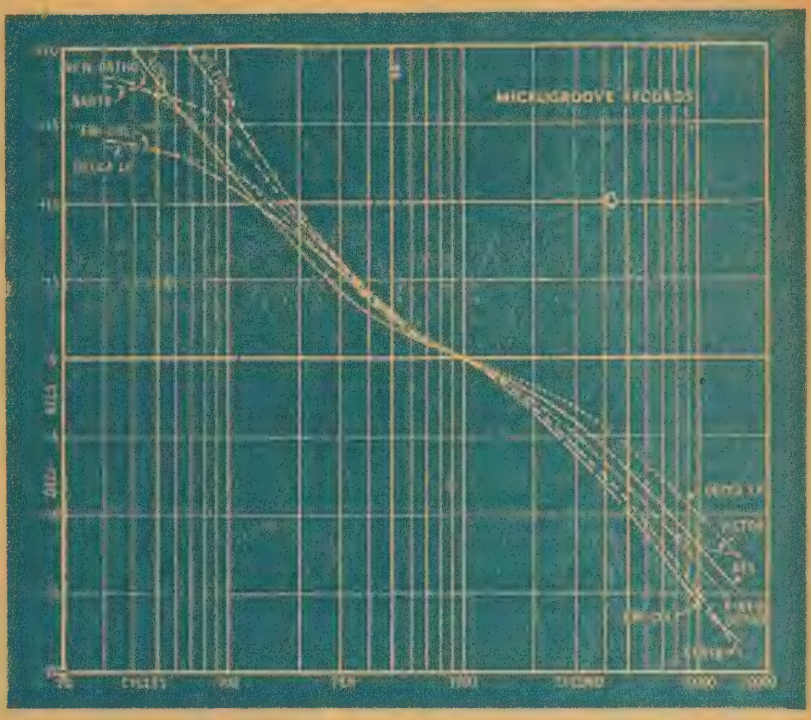
Some of them exhibit bumps and shapes that speak more eloquently of rulers and French curves than the response of electrical filters. Others show obvious confusion between the curves used by British and US manufacturers pressing the same label.

Some are presumably based on "guesstimation".

This point is the subject of a lament by a writer in an overseas magazine that I saw recently. Having discovered that much of the existing information was inaccurate, he wrote directly to the major record manufacturers seeking the necessary information to design himself some filters.

Some answered promptly, some tardily, while others ignored his letters altogether!

MAIN MICROGROOVE CURVES



Here are the principal microgroove curves, related to playback compensation requirements. Note that the principal regions of divergence are in the extreme bass and treble and therefore most likely to be noticed on wide range equipment. Do the variations account for all the talk of "vast differences" or is there a high proportion of self-delusion?

In preparing the curves shown in figure 2, I checked through all the references I could find, rejected those which appeared to be obvious mistakes and averaged out values that appeared to be in doubt due to drawing errors.

I know, therefore, that the curves do not cross-check with all published data, and I can't even swear that they are completely accurate. But they shouldn't be very far out.

A COUPLE OF POINTS

Without trying to draw too many conclusions at this stage, the point I made earlier can readily be appreciated. Over the range covered by the ordinary radiogram—say from 70 to 6000 cps at the best—the deviation between the more popular curves is not more than 4db overall, or a mere 2db from a possible compromise curve.

It is only in the extreme bass and the extreme treble that the deviation becomes great enough to become obvious to a critical listener. Or so it would appear.

A further point is that a lot of the talk about bass turnover is rather mis-directed. In point of fact, the bass and treble curves are so intimately linked that it is hard to separate the individual turnover points.

The bass roll-off is much more significant to the user of wide-range equipment.

How the curves came to acquire their individual shapes is a story in itself. Some of them grew up from a recording engineer's slide-rule, or, to be more explicit, from basic calculations of maximum amplitude and maximum acceleration.

They were modified, in their development, to bring them into line with what could be accomplished with filters and with cutting heads, what could be processed during manufacture and what could be expected of the playback equipment. That different firms derived different answers to all this is not to be wondered at.

The Ortho-NAB-NARTB characteristic, on the other hand, is the outcome of efforts by the US National Association of Broadcasters to solve their own special problems of playing a variety of differently equalised records.

Their objective has been to derive a curve which would allow satisfactory playback of many existing discs, as well as provide a standard for future recordings.

AES CURVE

The AES curve, recommended by the Audio Engineering Society, resulted from a different approach again. The society reasoned that response curves which involved a complex equaliser were just "too hard" for other than professional groups.

Since the records must largely be played back on domestic equipment, they should be capable of proper

and now...

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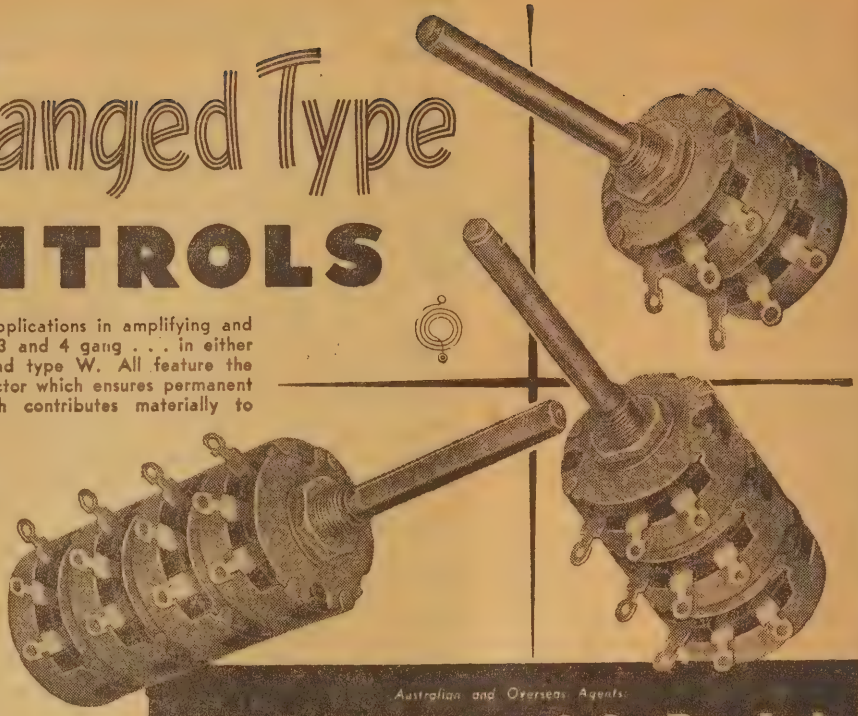

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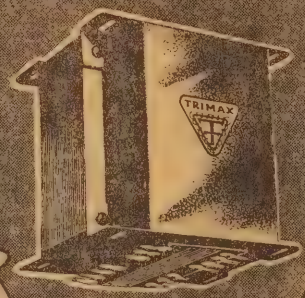

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equalisation with only simple corrective networks. The ideal would, therefore, be the natural rise or fall obtained by using simple series or shunt capacitors.

The AES curve, as shown, is based on these premises, and can be seen to occupy a position on the graph largely intermediate between the other curves.

Sponsors of the AES characteristic believe as follows:

(1) That domestic audio systems should be arranged to give an OVER-ALL response equivalent to the AES curve.

(2) That record manufacturers should at least arrange their equalisation to give an acceptable balance when played back through an AES compensated system, and

(3) That ideally all records should be made in future with a recording law exactly inverse to the AES playback characteristic.

The whole argument seems so logical that, if the record companies are ever to adopt some universal standard, it might well be the one suggested by the Audio Engineering Society.

WHY NOT 78's?

Considering also the advances in 78 rpm techniques, there seems to be no special reason why these discs also should not fall into line. Must we always live with the idea that 78 rpm records must remain "pleasant" on acoustic gramophones?

Of course, it may be contended that the AES curve is fine, except that it involves a lot of boost at the very low frequencies, with the consequent danger of amplifying "rumble" components.

It would be a very simple matter to provide a little bit of bass roll-off and overcome this objection. But, of course, this produces yet another "standard" and puts us right back to where we started. Perhaps RCA's "New Ortho" would be a better choice.

So the game goes on!

However, be that as it may, we at least have on paper for reference purposes what appear to be the most commonly used recording characteristics.

And this brings us to a delightful little discussion on "Who uses these characteristics?" I mean who among the sponsors of between two and three hundred different LP labels?

It must be nearly as hard to think up a new record brand these days as it is to think up a new name for a Radio and Hobbies receiver.

TYPICAL INFORMATION

I've set out in the table the kind of information that is available and to which many compensating units have been designed. But there are plenty of "ifs" and "buts".

While it should be self-evident that "London" records in the US would have the same equalisation as English Deccas, a copy of the "official" London curve differs in shape from a copy of the English curve. The ends and the middle are in the same place but the parts in between don't correspond.

Is there really a difference or did the draughtsmen involved use a different set of French curves?

For good measure, a much esteemed Australian textbook quotes figures for them which are quite different again. Perhaps they refer to the American Decca, which isn't the same as English Decca!

Mercury have switched from the Columbia characteristic in their earlier recordings to AES.

Westminster switched from NARTB to AES. A little later there was talk of a new richer bass, which apparently involves recording with an AES treble characteristic and a Columbia bass characteristic.

RCA are said to admit that the recording practice surrounding many of their earlier discs is confused. Apart from special filters, they have used both the "Victor" characteristic and the New Orthophonic.

Hints and tips about changes in recording practice have become a more or less routine subject in magazines specialising in this kind of thing.

I haven't even mentioned European discs which doubtless have a story all their own. It will concern us as the said discs reach the local market in one guise or another.

And from this world-wide interchange of recordings springs another possible source of confusion. If the recipient company is supplied with a "mother", it will naturally carry the characteristics used by the originating studio.

If a tape is supplied, however, it will logically be transcribed to the local standard. How is the poor user ever to know?

It seems to me that the only logical answer is a special "Audio Intelligence Bureau", supported by annual subscriptions from all keen record fans. The function of the bureau would be to ascertain the history and breeding of all known recordings, much as is done, I understand, with racehorses and pedigree dogs.

For an additional small fee, they would tell you where to set your compensator for each particular record — before you start altering the remaining tone controls to make it sound better!

There is, of course, another answer to the problem which I can only bring myself to mention, very shamefacedly. I have in mind some little letters scratched on to the master like "AES" or "Col." But forgive me, I'm being silly.

Microgroove Standards

EMI-COL: Columbia (US or British,; Early Mercury; Victor (pressed in England); Vanguard; Bach-Guild (released as Nixa), Vox; Cetra-Soria (with NARTB treble); Latest Westminster (with AES treble.)

DECCA: English Decca; London (similar if not identical.)

AES: American Decca; US Capitol; recent Mercury; recent Westminst- (often marked.)

NARTB: (embraces former NAB and Ortho curves) MGM; Artist; Tempo; Early Westminsters.

NEW ORTHO: Victor and other RCA pressings since about 1953; HMV (American pressings.)

VICTOR: Victor and other RCA pressings prior to about 1953; HMV (American pressings.)

JUST MORBID

Perhaps I'm being morbid too, but, as I warned you in the first place, that's what comes of poring too long and too closely over recording curves!

And it will make the Editor look awfully clever, if he can come up with a practical answer to the problem. (What a build-up!)

At this stage, with the space running short, I must be content to let the matter rest there. A good deal remains to be said but it perforce must wait until some future occasion.

I must thank several readers who have expressed appreciation of last mon'h's dissertation on the problems of high fidelity.

Among them was "L.W." himself, the writer of the original letter. On a visit to Sydney, he called to say that my summing up of his problems was pretty close to the mark. When last seen, he was all set to build up the new "Playmaster" equipment described in this issue.

He was also busily trying to figure out how he could fit a High-G crystal cartridge to his record changer arm. Is he downhearted? No sir, he's just itching to get started again! That's the way it is with audio.

And what of the other man, the instrumentalist, with motor trouble? Just as I tipped, he just couldn't be bothered messing around with the cheaper motor but went off and paid over his 30 odd pounds for a high quality one.

VERY HAPPY

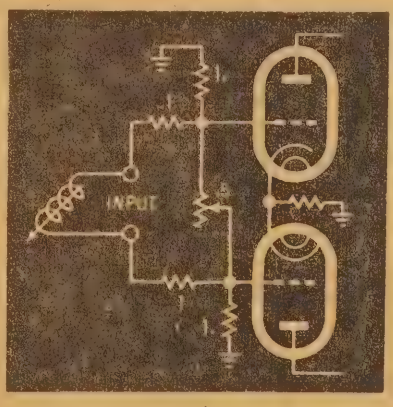
According to latest reports, he's so happy with the results that he's completely forgotten the amended figure in his cheque account. I only wish I could forget figures like that so easily!

A couple of folk, who weren't nearly so happy, have written in to query the circuit on page 87 of the April issue. One suggested that it may have been meant as an April fool's joke. The other reader was rather more complimentary. He agreed that it probably did work but couldn't just see how.

Well, the circuit is wrong as it stands, not in regard to the push-pull principle which it illustrates, but in the lack of a DC return path for the grids. I'm afraid that I was so preoccupied with the principle that I forgot the details.

To make the circuit right, it would be necessary to add the two resistors shown in the new diagram—say a **1.0** meg. from each grid to earth.

Happy now?



Reprinted from page 87 of the April issue, this diagram contains an additional and rather important provision —a DC return and at CT reference point for the grids.

NEW FIVE VALVE DUAL WAVE RADIOGRAM-CHASSIS

£17/17/6
PACKING and FREIGHT EXTRA

FULLY GUARANTEED

These chassis give excellent local, interstate and overseas reception, and are fitted with pick-up terminals and radiogram switch. On-off switch is fitted to enable power to be switched off from set.

Supplied tested and complete in every detail with five standard valves, 6J8G, 6SK7G, 6SQ7G, 6V6G, 6X5G, and 12in Rola or Magnavox speaker.

SHOP-SOILED—3-SPEED—RECORD CHANGERS

COLLARO
3/511 and 3/521
3-SPEED CHANGER

With lightweight, high fidelity twin crystal heads.

£11/10/-
FREIGHT EXTRA

STROMBERG CARLSON
VELVET-ACTION
3-SPEED CHANGER

With turn-over crystal pick-up.

£15/17/6
FREIGHT EXTRA

PLESSEY
3-SPEED MIXER
RECORD CHANGER

With high fidelity crystal pick-up dual stylis.

£11/17/6
FREIGHT EXTRA

NEW PHILIPS MICROGROOVE RECORD PLAYER

Philips and Mullard two-speed (78 and 33 rpm) microgroove record players. These units are fitted with a high fidelity turn-over crystal pick-up and automatic stop.

£5/19/6 Postage NSW 8/-; Interstate 12/-. (extra).

Portable leatherette cabinet suitable for above **£3/15/-**

Cabinet suitable for record changer **£5/10/-**

Synchronous motor and drive in this unit is ideal for tape recorders.

NEW COLLARO SINGLE-SPEED RECORD PLAYERS
Type AC54 single-speed record player with high-fidelity crystal head and automatic stop. For 240 Volts AC operation.

Special Price
£3/5/0
PLUS POSTAGE
Interstate 8/6, NSW 5/-

ROTHERMEL SAPPHIRE NEEDLE PLAYS 2000 RECORDINGS, 5/6

CRYSTAL PICK-UP CARTRIDGES
Rothermel high fidelity pick-up cartridges, replacement for most pick-ups.

METROPOLITAN RADIO SUPPLIES

479 Parramatta Rd., Leichhardt, N.S.W.
(At top of Taverner's Hill)
PHONE LM3610

NEW—SPEAKERS—AT—HALF—PRICE

6in SPEAKERS

HEAVY-DUTY PERMAGNETIC WITH 15,000 OHM TRANSFORMER **29/-**

POSTAGE AND PACKING

	NSW	Interstate
12in SPEAKERS	7/6	12/6
8in SPEAKERS	5/6	9/6
6in SPEAKERS	5/-	8/6
TRANSFORMERS	1/6	

12in SPEAKERS

HEAVY-DUTY PERMAGNETIC WITH 5000 OR 10,000 C. T. TRANSFORMER **54/-**

WITH 15,000 OR 20,000 TRANSFORMER 50/-

Separate Transformers to suit any of above speakers—5000 ohm 8/6 each (Supplied with speakers only)

NEW—DYNAMIC—SPEAKERS

New 7in dynamic speaker by leading manufacturer 1500 ohm field coil, 7000 ohm transformer -- -- -- 27/6

New ovaltone dynamic speakers 9in by 6in 1,000 ohm field and 5000 or 7000 ohm transformer -- -- -- 27/6

SPECIAL PRICE FOR QUANTITY

Postage N.S.W. 3/6. Interstate 5/6

POSTAGE AS ABOVE

NEW VALVES IN CARTONS

SPECIALS (Ex-Disposals)

12SH7 .. .. 7/6	6K7G 8/6	6SH7 .. .. 7/6
12A6 .. .. 12/6	5U7G 12/6	7193 .. .. 5/-
12SL7 .. .. 12/6	6SA7GT .. 12/6	EF50 with socket .. 11/6
12SJ7 .. .. 12/6	6SK7GT .. 12/6	6SH7 or 1K5 5/- in dozen lot.
12SK7 .. .. 12/6	6SQ7GT .. 12/6	
9001 .. .. 10/-	6SN7GT .. 10/-	
9004 .. .. 10/-	6C4 .. .. .. 15/-	6J8G 17/6
AV11 .. .. 9/9	6AG5 .. .. 15/-	6AC7 .. .. 12/6
1K7G 9/6	1T4 .. .. .. 15/-	955 (acorn) 12/6
1M5G 9/6	VR65A 3/6	957 (acorn) 10/-
1C7G 11/6	6AG7 .. .. 12/6	6AK5 .. .. 15/-
1L5G 10/6	1K5 .. .. .. 3/6	

Please add postage

New Electrolytic Condensers

12 mfd-525V **4/6** each or **48/-** dozen plus post

8 mfd-350V **2/6** each or **24/-** dozen plus post

4 mfd-600V **2/6** each or **24/-** dozen plus post

16 mfd-350V **3/-** each or **30/-** dozen plus post

10 mfd-40V **2/-** each or **21/-** dozen plus post

NEW GERMANIUM DIODES TYPE 4A42

Ideal for use as Crystal Detectors, Noise Suppressors, etc -- -- -- -- -- -- -- -- -- -- **7/6**

POST FREE

NEW COILS AND INTERMEDIATE TRANS, By A LEADING MANUFACTURER

Permatune I.F. trans. 455K.C. -- -- -- **9/6**

Aer. Permatune B.C. coils 455K.C. -- -- **7/6**

R.F. Permatune B.C. coils 455K.C. -- -- **7/6**

Osc. Permatune B.C. coils 455K.C. -- -- **7/6**

Aer. Permatune S.W. coils 16-50M. -- -- **6/6**

R.F. Permatune S.W. coils 16-50M. -- -- **6/6**

Osc. Permatune S.W. coils 16-50M. -- -- **6/6**

METROPOLITAN RADIO SUPPLIES

479 Parramatta Rd:, Leichhardt, N.S.W.

(At top of Taverner's Hill)

PHONE LM3610

NEW VALVE SOCKETS

Teleton 8-pin octal moulded sockets **5/-** per dozen or **25/-** per 100.

American 8-pin Loctal high insulation **5/-** per dozen or **25/-** per 100.

CARBON RESISTORS

Well known make of carbon resistors in values of 100 ohms to 5 megohms. In 1-watt, ½-watt and 1/3 watt. All resistors are standard color coded and in original cartons. In lots of 100 mixed values comprising 50 1-watt, 25 ½-watt, 25 1/3-watt. .. Post, 1/6. **12/6**

IN LOTS OF 500, 50/-.

SOLDER

English multi-core solder in 1lb reels.

12/6 per lb.

Postage extra

NEW MERUCRY SWITCHES

The switch with a 1000 uses.

2/9 each

SPECIAL PURCHASE 100 NEW "PAILLARD" RECORD CHANGERS

The "Paillard" record changer has a variable speed motor making it ideal for dance halls, etc., and is fitted with a high fidelity crystal pick-up. Sapphire needle supplied with each unit.

BARGAIN PRICE **£7/18/6**

In orginal cartons — freight extra.

NYLEX HOOK-UP WIRE AT HALF PRICE

Nylex hook-up wire 10/.010 in 100 yard coils, each coil consisting of five 20 yard lengths in 5 different colours.

10/- PER 100yds. Plus postage

A.R.8 RECEIVERS

AR8 Receivers made by A.W.A.. Eleven valves. Covering all frequencies from 140 K.C. to 20 M.C., valves required 3—6A8G, 4—6U7G or 6K7G, 1—6J7G, 1—6J5, 4—6B8G, 1—6X5G. (Circuit supplied.)

Price less valves and covers £9/10/-
Less valves, covers and dials £7/-/-
Freight extra.

A.T.5 TRANSMITTERS

AT5 Transmitter in good condition less valves. Frequency coverage 140 K.C. to 20 M.C. Valves required 3—807 and 2—6V6. (Circuit supplied).

Less valves £5/5/-
Less valves and covers £4/5/-
Freight extra.

A.R.7 COMMUNICATIONS RECEIVER

These popular receivers covering from 140 KC to 25 MCS. In five bands. Feature signal strength meter, crystal gate, noise limiter, two RF and two IF stages.

Supplied complete with nine valves, five sets coils, AC/Vib power supply, speaker and mounting rack.

AIR TESTED **£47/10/-**

HIGH-POWER I.R.C. RHEOSTATS

250 ohm, 25 watt.
10 ohm, 2½ amp; 25 ohm, 1 amp
Price, each **10/6**

50-CYCLE A.C. AMMETERS

Range 0-14 Amps. Scale Size 4in. Dia. Brand New.

Price, each,

45/-

Packing and postage: NSW, 3/-; Interstate, 5/6.

BUTTERFLY CONDENSERS Capacitance range 3-35 microfarad. Size 1¼ x 2⅜ x 2¼ inches. Brass plates: Ultra high frequency insulation: ¼-inch shaft.
Price, each **7/6**

Packing and postage: NSW, 1/-; Q., T. and V., 1/6; W.A., N.T., 2/-.

NEW A.W.A. VIBRATORS

6 volt A.W.A. gas filled vibrators, heavy duty, synchronous.
Price **15/-**
(Special price for quantity.)

D.C. GENERATORS

12v 750 watt. Ideal Home lighting, Battery charging, etc.
PRICE £4/10/- F.O.R.

TRICKLE-CHARGER KITS

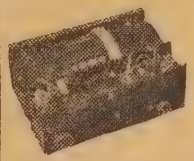
Kits for trickle-charger as described in R. & H., June issue. Comprising transformer with 18V winding tapped at 12V-3 100mA rectifiers and 50 ohms control.
Postage: NSW, 5/-; Interstate, 7/6. **39/6**

1143A. TRANSCEIVERS

(English equivalent to SCR 522)
Frequency range 100 to 156 m/cs
Complete with 20 6.3V Valves.
New condition, supplied in transport case.

£12/15/- plus freight

SCR 522 GENEMOTORS



28 volt input D.C., regulated and filtered output filtered D.C. 300 volts at .26 amps; 150 volts at .01 amps; 14.5 volts at 5.0. Completely shielded in metal case, 12 x 8 x 5 inches.
Price, F.O.R. Each **55/-**

A.T.5-A.R.8 POWER SUPPLY

24 volt genemotors supply containing two genemotors, one giving 550 volt at 350 mills and the other 250 volt at 100 mills, also contains filter condensers, relays, fuse holders, etc.

£4/10/- **F.O.R.**

TYPE 1133 TRANSCEIVER

Freq. range 90 to 130 m/cs contains 17 6.3 volt valves.

£8/17/6

METROPOLITAN RADIO SUPPLIES

479 Parramatta Road,
Leichhardt, N.S.W.
(at top of Taverner's Hill)
PHONE LM3610

TRANSFORMER SPECIAL

H.D. Power Transformer, 265 x 265 250mA 4v Fil. Windings £2/5/-
H.D. Power Transformer, 365 x 365 150mA 4v Fil. Windings £2/5/-
C.R.O. Transformer, 1540v, 2v Filament Winding £2/5/-
150mA Filter Choke £1/2/6
Prices F.O.R.

NEW MN26 COMPASS CONTROL-BOX 37/6

6in Flexible drive for above, 10/-. 24in, 18/6.
Postage extra.

SPECIALS

Carbon Mike Inserts	2/6
Bakelite Fuse Boxes	4/6
5-Position Push Button Switches	10/6
Carbon Mike Trans.	4/6
Double Button Carbon Mikes	7/6
Throat Mikes	5/-
Cutler Hammer Switches	2/6
Shielded Hook-up Wire, yard	8d
3 gang Standard Condenser	20/-
Twin Co-ax Cable, 20ft lengths	6/-
2 gang Condenser	16/-

NEW WESTON & FERRANTI METERS

0-.5 amp. RF thermocouple	9/6
0-3 amp. RF thermocouple	9/6
0-4 amp. RF thermocouple	9/6
0-10mA DC	17/6
0-20 volt DC	17/6
0-5 amp. DC	27/6
0-10 amp. DC	27/6

(All above are 2in flush mount.)
0-10mA DC English Turner 3in Round Flush Mounting 30/-
Postage Extra.

NEW---AMERICAN TELEPHONE WIRE

Rubber insulation with stainless steel and copper conductors supplied on metal reels each containing half-mile of wire. **£1/15/- per reel**
In case lots, each containing six reels (three miles of wire). **£10** PER CASE F.O.R.

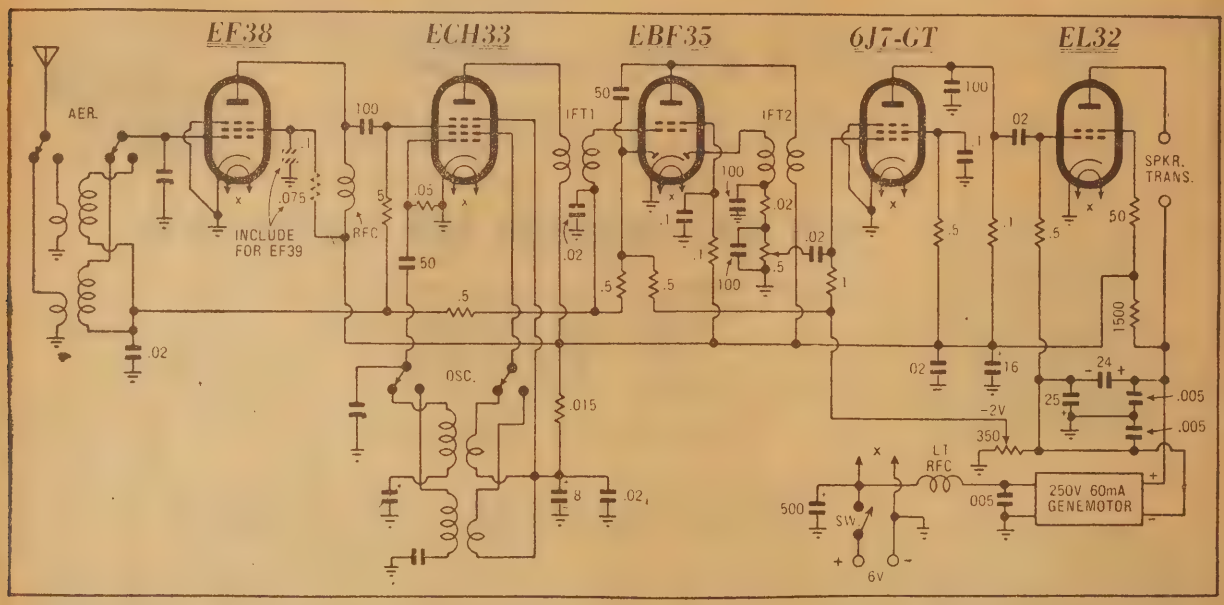
A MOTOR WITH MANY USES

Small 24-volt motor suitable for AC or DC, reversible operation, fully laminated. Approx. one-fifteenth H.P. Size 3¾in x 2½in. ¼in Spindle. Mounting bracket supplied .. .. ..

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

DUAL-WAVE CAR RADIO OPERATES FROM GENEMOTOR



No doubt many readers would like to build a car radio using as many "disposal" items as is possible. Here is a design which will help you to do that. Futhermore, the use of a genemotor supply lessens the problem of "hash" interference sometimes encountered with a vibrator supply.

ACCORDING to our contributor, Mr. H. Iffla, of 33 Forrest St., Kalgoorlie, Western Australia, the performance of this set has been found to be equal to many of the commercial models.

The set employs five valves, most of which can be obtained from disposals equipment, particularly that of British origin. One advantage in using these types is that the .2 ampere heater rating results in a saving in total heater current drain of more than .5 ampere when compared with similar types in the Australian or American series.

NO RF COIL

An interesting feature of the RF and converter stages is the omission of the RF coil and the consequent use of only a 2-section gang tuning capacitor with a standard dual-wave coil unit.

This is achieved by replacing the usual RF coil with a standard RF choke and using capacitance coupling to the converter grid. The overall gain will not be quite as high as when an RF coil is used but it should, neverthless, be valuable.

The use of a dual wave coil unit would be a matter for individual preference. In most cases, broadcast programs would be all that is required, although there will, no doubt, be some readers who are interested in having short-wave reception available.

Our contributor points out that because of interference from the car ignition system, he uses the short-wave section only when the car is stationary. It is not impossible, of course, to improve matters, provided that one is prepared to spend some time with shielding and suppressors on various parts of the car wiring.

It appears in this design that the anode of the EL32 operates at 250 volts while the remainder of the set is fed from a decoupled point of about 200 volts. The 1500 ohm decoupling resistor should be of 3 watt rating.

The cathode of each valve is connected direct to chassis and all stages are biased by the voltage developed across the back-bias resistor between HT minus and chassis. The first three stages are biased via the AVC line by returning the AVC diode anode load resistor to a tapping on the back-bias resistor. In the circumstances, this 350 ohm resistor should be of the wirewound type with an adjustable tapping.

This form of biasing does eliminate a large number of components which would otherwise be required for individual cathode-biasing of the stages. For this same reason, no doubt, our contributor used an EF38 in the RF stage. Its 250 volt screen rating permits the screen to be connected direct to the HT line, thus eliminating the usual screen dropping resistor and bypass capacitor.

SCREEN CIRCUIT

If an EF39 is used, its 100 volt screen rating will require the screen components shown dotted in the circuit.

The EL32 in the output stage is a logical choice in view of its .2 ampere heater rating and its reasonable power output for a cathode current around 30 mA.

The optimum load impedance for the EL32 with 250 volts on both anode and screen is 8000 ohms. In the circumstances, however, load impedance up to 10,000 ohms should be satisfactory.

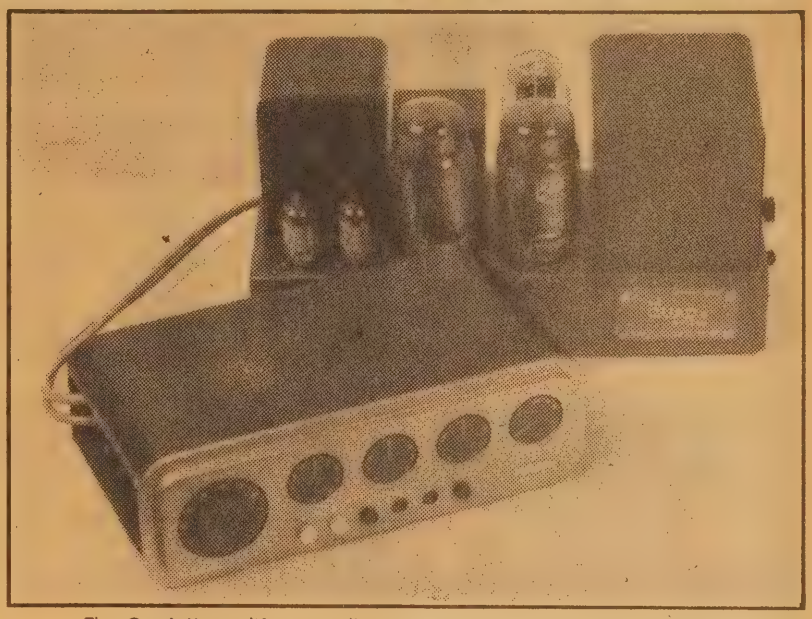
According to our contributor, the filtering of the 6 volt input and the output of the genemotor is sufficient to maintain hum and HF interference at a low level.

He mounted the genemotor on the engine side of the firewall to lessen the amount of mechanical noise.

TRADE REVIEWS AND RELEASES

QUAD AMPLIFIER HAS AN IMPRESSIVE PERFORMANCE

Amplifiers made by the Acoustical Manufacturing Co. Ltd. of Huntingdon, England, have always been famous for their high standard of performance. The "Quad II" amplifier shown here demonstrated during our tests why it has enjoyed such a high reputation.



The Quad II amplifier is well made and has superlative performance.

BOTH mechanically and electrically careful design is the keynote. We see the conventional amplifier properly coupled to a control unit in which pre-amplification and compensation is carried out. Both units have features quite unlike those of its competitors.

The control unit is a somewhat complicated device, but it is beautifully built and extremely flexible. A wide degree of compensation is available, not only through pre-set positions but also by auxiliary bass and treble controls.

The pre-set positions are push-button operated, giving Columbia, AES, FFRR 78 and Standard 78 positions. By combining these we get in addition NAB, RCA Orthophonic, and NAB bass-AES treble which is sometimes used.

Two more buttons bring in the radio or microphone circuits.

The extra bass and treble controls are continuously variable giving boost and cut for each.

Two more knobs operate a "slope" circuit which gives varying degrees of roll-off starting at 5, 7.5 and 10 Kc. One position removes the slope, allowing the amplifier to play "flat".

The volume control knob is large and easy to use. The front panel is a casting, and has a most attractive appearance.

To adjust the input circuit for a wide variety of pick-ups there is an input socket into which appropriate compensating units—about the size of a miniature valve — may be plugged.

All compensation is carried out by feedback networks using two valves —an EF86 and an ECC83. There is also a red panel light which shines when operating.

The main amplifier uses a circuit exclusive to Quad, the main feature of which is a method of coupling the output valves to the load through a multi-wound, specially designed transformer, an idea which excited great interest when elaborated in the English Wireless World of September, 1952. The valves are driven by two EF86's with feedback over the complete amplifier.

The figures of output, response and distortion are extremely good. Less than .1 pc distortion is claimed at 12 watts and a variation of not less than .5 db between 20 and 50,000 cycles.

Noise level is -88 db referred to 15 watts. The amplifier is claimed to be completely stable under any conditions of load. Impedances of 15 and 7 ohms output are available.

Our checks substantially bore out all the claims made for this amplifier, the standard of which is far above that required for playing gramophone records. It is not cheap to buy, but its facilities and its performance are really impressive. Workmanship throughout is of the highest quality.

The amplifier was submitted for test by British Merchandising Pty. Ltd., 188 Pitt St., Sydney, the Australian agents.

MINIATURE IRON FOR FINE WORK

A feature of electronic equipment manufacture in recent years has been the universal use of small components. These have demanded a new standard in soldering irons, which must now be not only small, but more convenient to use.

A NEWCOMER to the Australian market is the Oryx sub-miniature soldering iron made in England and distributed in Australia by Manufacturers Special Products, 47 York St., Sydney.

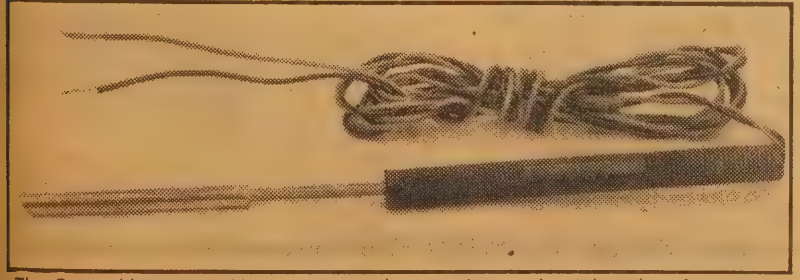
This is a low voltage iron, available for 6-volt operation and in the larger sizes for 12 and 24 volts. It measures about 6in in length and weighs only a few ounces.

For very fine work No. 6 iron has a 1-16th diameter fixed bit, and No. 6a a 3-32 bit, both with 6-watt elements.

Two heavier versions are the No. 9 which has an 8-watt element and a 5-32 removable bit, and the No. 12 with a 12-watt element and a 3-16 removable bit.

In use we found the iron particularly handy and effective. Warm-up time on 6 volts is approximately 45 seconds, and the No. 6 was quite capable of dealing with quite substantial joints and even soldering leads to light tinplate.

The Oryx is not intended to replace your heavier iron, but it is invaluable for soldering light leads, for use in tight corners and for doing most routine work.

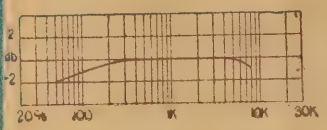


The Oryx soldering iron No. 6 measures about 6in long and weighs only a few ounces.

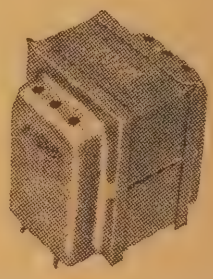
FERGUSON — FOR ALL YOUR AUDIO OUTPUT TRANSFORMER REQUIREMENTS

PUBLIC ADDRESS RANGE
50-8000 C/S ± 2 dB

This range is designed for use with public address systems, factory music while you work, etc. A small section of our extensive range is presented below.

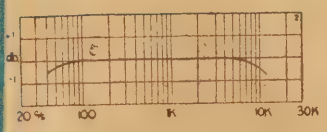


Code No.	Watts	PRIM. Z.	SEC. Z.
OP-1	10	5000, 2500 SE	12.5, 8, 2.3
OP-1A	10	5000, 2500 SE	500
OP-2	15	5000 PP	12.5, 8, 2.3
OP-3	15	6600 PP	12.5, 8, 2.3
OP-4	15	10000 PP	12.5, 8, 2.3
OP-11	25	6600 PP	500, 250, 125
OP-12	25	10000 PP	500, 250, 125
OP-15	32	6600 PP	500, 250, 125
OP-16	32	10000 PP	500, 250, 125
OP-37	80	6400 PP	500, 250, 125

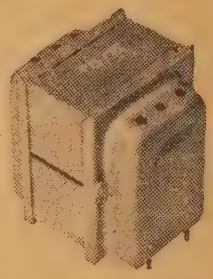


MEDIUM FIDELITY RANGE
40-17000 C/S ± 1 dB

This range has been especially designed for use with the Rola 12-OX speaker. These transformers are especially suitable to use with triodes.

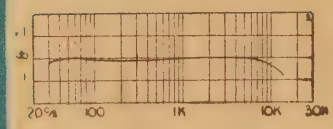


Code No.	Watts	PRIM Z.	SEC. Z.
OP-112	6	10000 PP	2
OP-113	6	5000 SE	2
OP-117	6	5000 PP	2
OP-118	6	8000 PP	2
OP-119	6	6600 PP	2
OP-183	6	7000 SE	15, 2

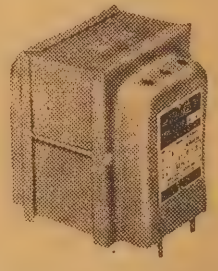


HIGH FIDELITY RANGE
30-15000 C/S ± 1 dB

These transformers are primarily for use with Goodman and other extended frequency response speakers. Section below is only small part of our range.

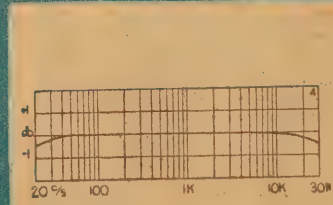


Code No.	Watts	PRIM. Z.	SEC. Z.
OP-22	10	3250 SE	500, 25, 2.3
OP-23	10	3250 SE	12.5, 8, 4, 2.1
OP-19A	15	5000 PP	12.5, 8, 2.3
OP-19B	15	5000 PP	500, 250, 125
OP-21	15	8000 PP	500, 250, 125
OP-62	15	10000 PP	500, 125
OP-63	15	10000 PP	15, 3.75
OP-64	15	10000 PP	12.5, 3.125
OP-65	15	10000 PP	8.4, 2.1
OP-51	20	4500 PP	15.5, 12.5, 8.6, 2.8, 2

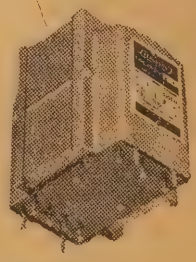


SPECIAL HI-FI RANGE
20-30000 C/S ± 0.5 dB

These transformers are for use in the Williamson Amplifier, and fulfil every requirement specified by D. N. T. Williamson.

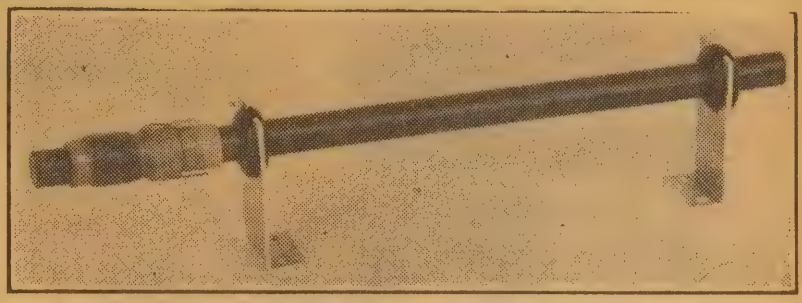


Code No.	Watts	PRIM. Z.	SEC. Z.
OP25/500	15	10000 PP	500, 125
OP25/250	15	10000 PP	250, 62.5
OP25/40	15	10000 PP	40, 10
OP25/16	15	10000 PP	16, 4
OP25/15	15	10000 PP	15, 3.75
OP25/12	15	10000 PP	12, 3
OP25/10	15	10000 PP	10, 2.5
OP25/8.4	15	10000 PP	8.4, 2.1
OP-66	15	5000 PP	8.4, 3.7
OP-67	15	5000 PP	15, 6.5



Ferguson Transformers Pty. Ltd., Ferguson Lane, Chatswood—Phone JA2878. Available from retailers in every State

AEGIS MFG. RELEASE A NEW LOOP-STICK TYPE AERIAL



JNDER the name of "Signal Mag-net", the Aegis Mfg. Co. has cently released a loop-stick type rial for use in portable or mantel ceivers. It is intended to replace e normal loop aerial or aerial coil.

The prototype "Signal Magnet" as tested some time ago with our tambler" receiver, putting up an cellent performance. This and her tests have indicated that the op-stick type aerial is far better an small conventional loops and ill outperform all but the largest nd-wound types.

Supplies are available through egis distributors.

SHAVER SUPPLY

RONCORE Transformers Pty. Ltd. have added to their range a special nverter to operate electric shavers om 6, 12 and 32-volt supplies. The nit is intended for use in cars,

ravans, boats or from home light-g plants.

The retail price of the converter, shown above, is £8/12/6.

DECCA PICKUPS

JNITED Radio Distributors cur-rently hold stocks of Decca mag-tic pickups, fitted with the new -type LP head. Decca claims gher compliance for these heads, hter weight, and a flat response

15 Kc. Price of the pickup with o heads is 15 guineas.

URD also have in stock replace-ent diamond styli for Decca pick-s.

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Y78a

The complete power pack and midget accumulator side by side as they are housed in the unit. The size of the battery may be gauged by comparing it with the vibrator cartridge. The miniature four pin socket which provides connection to the main unit may be seen in front of the chassis.

A VIBRATOR PHOTO-FLASH

In this article we present the third version of our low voltage flash unit; a vibrator type power supply operating from a small "dry" accumulator. This version is ideally suited to the photographer who does only a limited amount of outdoor work and thus finds it inconvenient to use dry batteries.

by Philip Watson

BEFORE going into details about this version it may be as well to review briefly what we have already described and comment on the possible advantages and disadvantages of each. We can easily imagine that with three versions to choose from many readers may be prompted to ask "Which one is best?"

The dry battery-operated version described in the March issue has the advantage of light weight and low first cost, plus a simplicity of construction which should appeal particularly to the amateur photographer with only a little knowledge of electronics.

RUNNING COST

The running cost, while not something which can be completely ignored, is quite reasonable, probably amounting to about 2d per flash (maximum rating), according to estimates on battery life given by the battery manufacturers. The only snag is the relatively short shelf life for batteries of this kind, for the makers recommend that they should be discharged within six to nine months.

For anyone doing regular work on a professional or semi-professional basis it would not be at all unreasonable to expect that a set of batteries would be used in that time, or, possibly, much sooner.

However, most amateurs (indeed, the true amateurs) would probably expend only a fraction of the available number of flashes in this time.

After the novelty has worn off, they will probably be content to photograph their own and the neighbors' youngsters (at regular but fairly well-spaced intervals), "cover" party on odd occasions, as well as th special event which occurs in th community from time to time. I these circumstances they run the ver real risk of wasting most of the powe they have bought and thus payin dearly for the flashes actually used.

STORING BATTERIES

One method of improving the shel life of all batteries is to store ther in a refrigerator, the reduced tem perature decreasing the chemica action. This method has the blessin of the battery manufacturers and, i fact, is used to store certain types o batteries which normally deteriorat rapidly. Such a method should a least double the life of the batterie used in the Electroflash, and the onl disadvantage of the scheme is that takes from 24 to 36 hours for the bat tery to thaw completely and it wi not work properly until it has thawed However, where prior notice is likel to be available of the work to be done this is not a serious problem.

If, in the light of the foregoin limitations, you consider that the dr batteries would not be convenient, w suggest you consider either the A mains unit described last month o the vibrator unit about to be de scribed.

THE AC UNIT

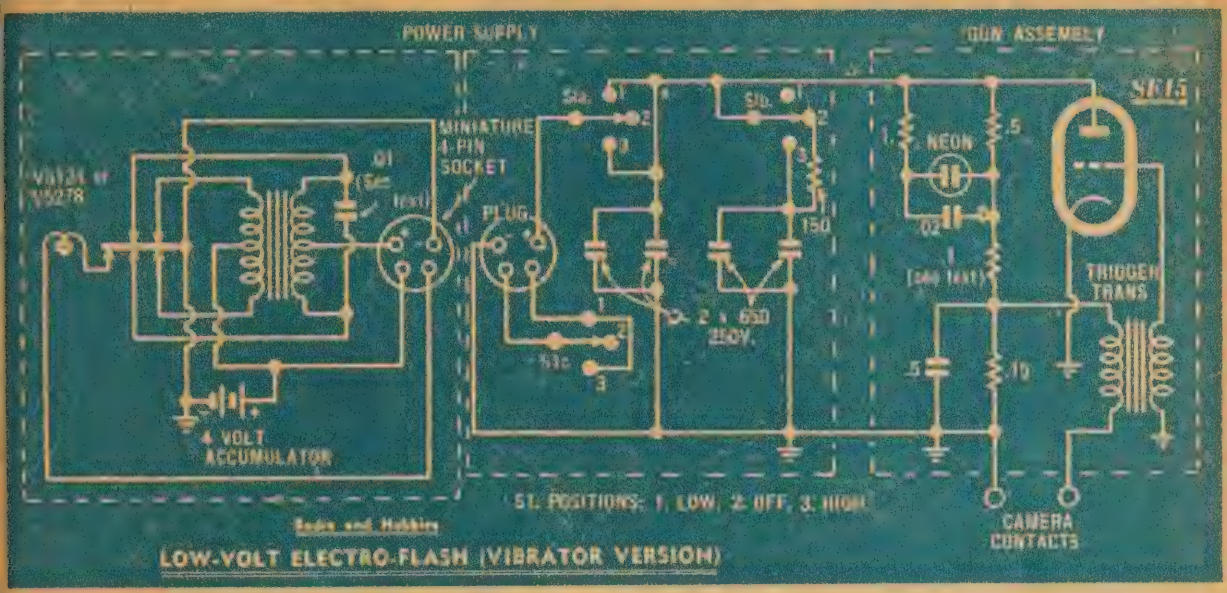
The AC mains unit will be a littl dearer as regards first cost, but cost virtually nothing to run. It weigh approximately the same as the dr battery operated unit but, of course must be used within range of a powe point. This last limitation is not a serious as it may at first appear, an the unit is still capable of providin a lot of fun and doing very usefu work around the home or at partie gatherings, &c., which are normall within range of a power point.

If you want to be completely in dependent of the mains but find th dry batteries undesirable for reason already mentioned, then the un about to be described should solv your problem.

Operating from a small "dry accumulator with the aid of a trans former and vibrator, it will cos virtually nothing for power, since th amount taken from the mains t charge the battery is so small as t be negligible. In this respect it more like the mains-operated ver sion but is completely self-containe and may be used anywhere.

As we seldom get anything fo nothing it is only fair to point ou the disadvantages as well. The un is a little heavier than the two pre vious versions, though not unduly s

CIRCUIT DIAGRAM OF VIBRATOR PHOTOFLASH



This is the circuit of the complete unit. On the right is the gun assembly, centre the capacitors and switching arrangements, and on the left the vibrator power pack. The plug and socket connection makes it a simple matter to substitute the AC pack described last month.

and will also cost more to build. At the same time it will still be much cheaper than an equivalent commercial version. (Assuming such is available.)

The first point which we considered when we set about designing this unit was the choice of a suitable battery. After all, this is likely to be the heaviest single component in the power supply and can quite easily wreck all one's good intentions about a lightweight unit by the time the transformer, vibrator and sundry minor bits and pieces have been added.

BATTERY DETAILS

The unit we finally chose consists of two 4AH two-volt "dry" accumulator cells, known as type VPT7/4. They measure 3 1-8in long, 1 5-16in wide and 2 7-16in high. Each cell weighs 11oz, making a total weight of less than a pound and a half. They also have the advantage of being about half the price of the VPT7/7, the next largest size.

At the same time there is room in the finished unit to house a pair of the latter, if they should happen to be available or the extra capacity is a real advantage.

Next item was the transformer. We wanted a unit which was reasonably light in weight, would charge the capacitors in at least as short a time as the dry batteries and would have internal losses low enough not to impose too severe a drain on the battery after the capacitors were charged.

Such a transformer is not easy to produce and some early samples from various manufacturers showed that all ideas about an ultra-miniature version would have to be abandoned. Certainly they worked, in the sense that they charged the capacitors, but the charging time was far too long. We therefore suggested a larger, and heavier, core on the assumption that a little extra weight was worth while to provide a reasonable charging time.

TRANSFORMER DETAILS

The final result is, we think, a fair compromise between weight and efficiency. It weighs 1lb 8oz, will charge to 225 volts (90 pc of the final voltage) in 10 seconds, to 240 volts in approximately 15 seconds, and has a standing current, including that for the reed, of 600 mA. The charging times for the 40 joule condition will be half those given above.

In case the reader is tempted to compare the above charging time figures with those of some commercial units, which will have their neon flashing in about three seconds, it may be as well to consider the reasons for this difference.

In the first place most commercial units are lower in rating than even the low setting of our unit (40 joules), being in the order of 28 to 30 joules. Secondly, it is common practice to set the neon indicator so that it fires at a point considerably below the top voltage, thus giving an apparently faster charging time.

Considered in this light, it will be seen that the five seconds required to charge 40 joules to 90 pc of the top voltage is not excessive. In other words, there is no magic formula for fast charging time and it can only be obtained at the expense of light output.

PARTS LIST

- 1 aluminium case 8½in by 5½in by 4in.
- 4 650 mfd 250 volt electrolytic capacitors.
- 1 .5 mfd 350 volt paper capacitor.
- 1 .02 mfd 350 volt paper capacitor
- 1 1 meg ½W resistor.
- 1 .5 meg ½W resistor.
- 1 .15 meg. ½W resistor.
- 1 .1 meg. ½W resistor (see text).
- 1 250 ohm 1W resistor.
- 1 150 ohm 1W resistor.
- 1 250V 100 joule flash tube, SF15 or similar.
- 1 miniature neon lamp.
- 1 trigger transformer.
- 1 3 pole 3 position switch.
- 1 reflector.
  Approximately 9in 1 3/8in OD 20g brass tube for gun.
- 1 single contact mic. plug and socket. 4ft twin plastic flex.
- 1 grommet ¼in hole.
- 3 3 terminal tag strips.
- 1 4 terminal tag strip.
- 1 8 terminal tag strip.
- 2 pieces of insulating bakelite approx. 3in by 4in.
- 1 pointer knob.
- 1 leather strap.
  Hook up wire, nuts and bolts solder lugs, insulating sleeving, 18g tinned copper wire, &c.

ADDITIONAL PARTS FOR VIBRATOR PACK

- 2 4AH, 2 volt dry accumulator cells, type VPT7/4.
- 1 special vibrator transformer, 4V to 250V.
- 1 chassis 2⅞in x 3 5/8in x 1⅛in.
- 1 vibrator cartridge, type V5278 or V5124 (see text).
- 1 8 terminal tag strip.
- 1 .01 mfd mica capacitor (for buffer, see text).
- 1 4 pin miniature speaker socket.
- 1 4 pin miniature speaker plug.
- 1 6 pin socket.

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- Kit No. 4
- Kit No. 1
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- 1952 Advance
- 1951 TRF Radiogram
- Super Three
- Simple Superhet
- "The E.P." Triple 6
- Multi Band 7
- 1953 "Little Jim"
- Vibragram 7
- Vibra 5
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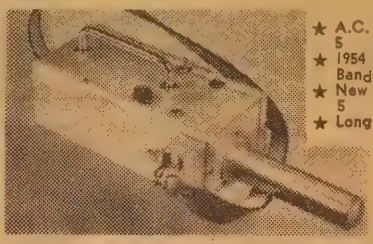

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- Vibrator Amplifier (6 Volt)
- Tuner No. 1 (2 Valve D/W & B/C)
- Whistle Filter
- Tuner No. 2 (3 Valve T.R.F. with Filter)
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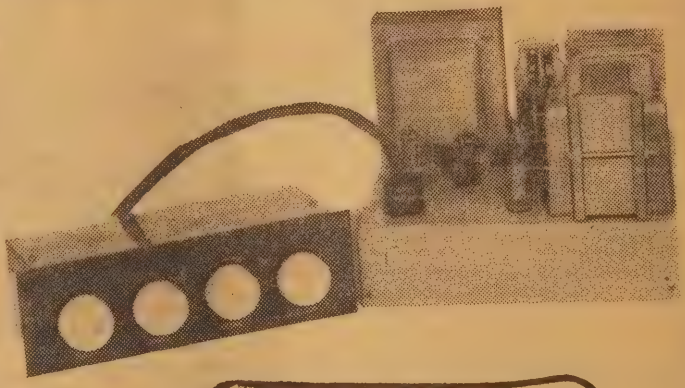
- Control Unit No. 1 (1 Valve with Vol. Cont.)
- Control Unit No. 2 (De Luxe Model)
- Control Unit No. 3 (Special Type)



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In addition to the battery and power transformer there is the vibrator (about 4oz) and several smaller components to make up the finished unit, bringing the total weight to 7lb 5oz, or less than 1lb heavier than the dry battery version. Considering the equipment involved, this is a very reasonable figure and should not cause any discomfort under normal working conditions.

It would, of course, be quite feasible to construct a unit one or two pounds lighter if one were content with the lower light output. Assuming that only two capacitors were used there would be an immediate saving of 1lb. To this could be added a saving in transformer weight, since a smaller version would now charge in a reasonable time. A smaller case would also be possible, thus saving a little more, but it is doubtful whether more than 2lb could be saved.

As with the charging time, an improvement in weight is only possible at the expense of light output and we think most fellows would rather use the larger unit for the sake of the extra light.

Coming now to the circuit, it will be seen that the gun, the main capacitors and the switching between them are the same as used for the previous units. The only difference in this section is the use of three-pole three-position switch in place of the previous two-pole three-position. Purpose of the extra section is to control the vibrator reed circuit.

It is so wired that it closes the circuit to the reed coil when in either the "high" or "low" position, but opens it in the "off" position. The space available for the switch is rather limited and one of the small types should be used for preference. It is possible to accommodate one of the standard sizes, but there is very little to spare and always the possibility of a short circuit to the case. The one we used is only about as big round as a penny.

The vibrator power supply is a perfectly normal arrangement of a synchronous vibrator, employing one set of contacts to change the 4 volts DC to AC and another set to rectify the AC output of the transformer after the voltage has been increased. As far as we know this is a rather unusual method for flash equipment, but the vibrator appears to be working within its ratings, at least on an intermittent basis, and shows no signs of distress when it is properly buffered.

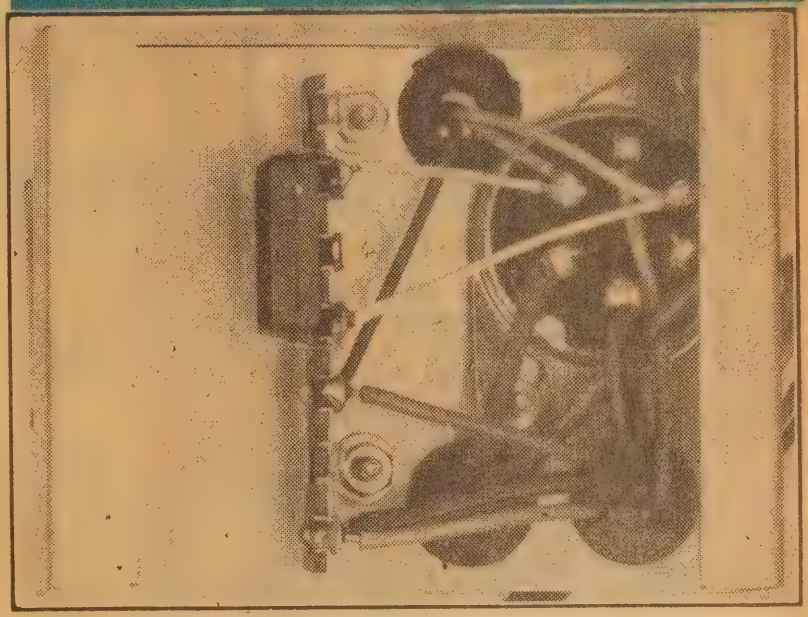
BUFFER VALUES

The matter of buffering is a very important one and the builder is advised to spend a little time checking this point. From the transformers we have been able to test so far a value of .01 mfd right across appears to be correct in most cases, but it is quite possible for the transformer you purchase to require a different value.

Fortunately it is not difficult for the amateur to check this point, the only equipment required being a meter capable of reading up to about one amp. At a pinch a rough-and-ready shunt may be connected across a standard multimeter, the accuracy of the meter not needing to be very high.

The meter is used to measure the standing current drawn from the battery when the secondary is open

UNDERCHASSIS OF POWER PACK



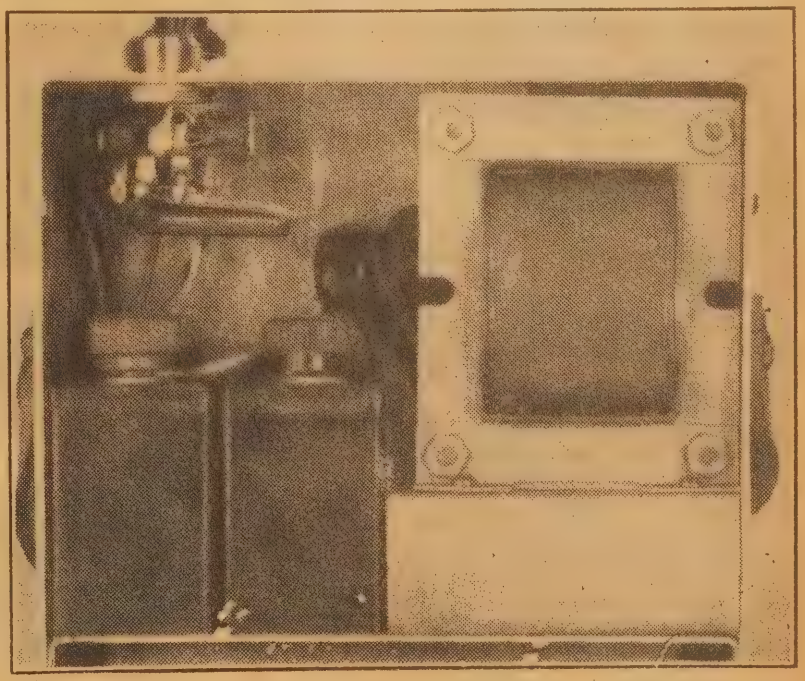
An under chassis view of the power pack. The small amount of wiring is plainly visible and should not cause any bother. Note the buffer capacitor mounted on the tag strip. Rubber grommets protect the wires where they pass through the chassis.

circuit, this being made up of the reed current for the vibrator and the losses in the transformer. When the correct value of buffer is employed this value will be close to minimum, so it is merely a matter of selecting values to produce this effect.

If anything, it is advisable to err on the side of too large a value rather than one which is too small, the larger value being able to take care of the slight increase in gap size which results from contact wear and compression of the contact spacers as the vibrator ages.

OTHER CASES

Although the transformer we finally chose needed a 0.1 mfd right across, some of the earlier samples and units from different manufac-



The batteries and power pack housed on the supporting shelf in the main case. The plug and socket assembly is just visible above one of the cells and the miniature three pole, three position switch can be seen at the top of the case.

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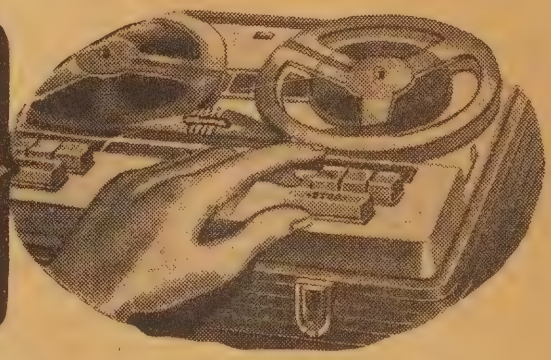

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turers needed values between .005 and .007 mfd right across. Therefore, be prepared to devote a little time to these experiments.

The vibrator we used is a standard six-volt synchronous type, and appears to work quite satisfactorily from four volts. Such an arrangement has the advantage that the reed current is reduced, but may, in some cases, reduce the efficiency of the vibrator slightly by reason of the reduced excursion of the reed and resultant poorer contact.

Tests carried out on our own unit showed that there was a slight improvement in performance when the reed coil was energised from six volts, but the difference did not amount to more than one or two seconds. However, if a new vibrator is to be purchased, it would be advisable to select a four-volt type, such as the V5278, or similar.

In deciding the physical layout, we kept in mind the idea of making the vibrator unit and AC unit interchangeable, if this could be done without additional complication. Although only a minor feature, it is one well worth having if it can be obtained at no extra cost. Since it is unlikely that any user will want to interchange dry batteries and the vibrator unit, we have eliminated all the circuitry previously employed for dry-battery operation.

CONNECTING PLUG

This leaves us with a connecting plug on the main unit with two of the pins connected to the main capacitors, and suitable for connecting to the socket on the AC unit. On the vibrator unit we provide a similar socket, similarly wired, but which carries two extra connections to the vibrator reed coil. From the plug on the main unit a pair of leads runs to the extra deck on the switch, thus providing the control circuit for the vibrator.

As can be seen from the photographs, the vibrator unit is mounted on a very small chassis, the batteries sitting on the shelf alongside. This provides sufficient head-room to allow the larger, 7/7 type, batteries to be used if desired.

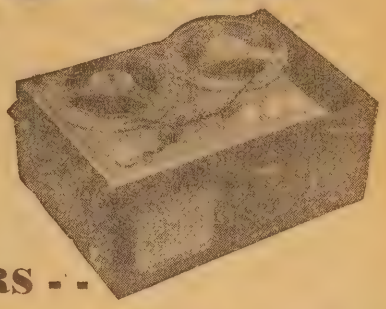
The chassis measures 2¾in by 2 5-8in by 1 1-8in. The ends of the chassis are bent under by about 3-8in, similar to the AC chassis. We have added the details of the chassis to the original blueprint covering the box and AC chassis, and commercial versions of all these should be available by the time this is published.

Assembly and wiring of the chassis is relatively simple. Three holes, fitted with grommets, are used to bring the leads from the transformer to the vibrator socket and to take leads above the chassis again for the power plug and battery. An eight-terminal tag strip, with the last terminal clipped off, is mounted under two of the transformer mounting bolts and serves to keep tidy the few leads which have to be extended.

The buffer capacitor is also mounted on this terminal strip, though it could be mounted directly on the socket. However, by shortening the pigtails, this arrangement makes a job better able to stand the vibration and bumps it is likely to encounter, and, since it is no more difficult, is to be preferred.

The wiring of the unit can be done with ordinary hook-up wire,

'NOVA'



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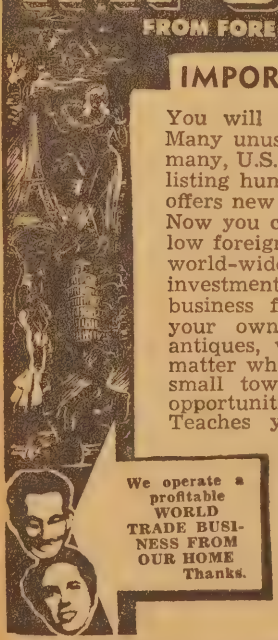

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the only exception being the leads from the battery to the under-side of the chassis. This is best made a little heavier to avoid voltage drop, and we used a short length of twin plastic flex. A scrap of red spaghetti slipped over the positive lead will serve to identify it.

Before completing the wiring it is important to check the polarity of the supply. This depends on the phasing of the primary and secondary windings of the vibrator transformer and the usual procedure is to connect the primary winding permanently and the secondary winding temporarily, leaving the leads long. The unit is now connected to the battery and the polarity checked with a meter, the secondary leads being transposed if the centre tap is negative and the "earth" positive.

Don't be surprised if the voltage is lower than the rated 250 volts at this stage, since this will only be realised with a substantial capacitor across the output.

CHECK POLARITY

Before making the final connection to the main capacitors, make quite sure that the plug and socket are wired correctly and that the positive lead is really connected to the positive pole of the capacitors. Electrolytics don't take kindly to reversed polarity.

In use, it is only necessary to set the switch to the required position ("HIGH" or "LOW") and wait for the neon to indicate that the capacitors are charged. If the picture is not to be taken for a few minutes, there is no objection to allowing the unit to continue running, particularly if the picture may have to be taken at short notice.

If the picture is not likely to be taken for a longer period, the unit may be switched off after the capacitors are charged, switching it on again for a few seconds before taking the picture to make good the leakage losses during the waiting period.

Immediately a flash is fired the capacitors commence to charge again automatically and the unit may be left running continuously when a lot of pictures have to be taken in a short time. In this way the photographer can devote all his attention to handling the camera and posing his subject, and need only adjust the flash unit if he requires to alter the light rating.

And now a few words about the

Alternative Arangement for Using AC Unit

A SUGGESTED alternative method of using the AC unit described last month is to mount it in a separate metal box and equip it wiith a moderate length of power flex and a long length of twin plastic flex to convey the DC output to capacitors in the main unit.

This arrangement has the dual advantage of reducing the weight which the photographer must carry and allowing the mains side of the circuit to be earthed by means of a three way cable while still permittinig the main extension to be nade with light twin flex.

accumulators. It is only fair to point out that these accumulators, like any other lead-acid type, have a definite life. This means that their depreciation must be allowed for in calculating the running cost of the unit and raises the point as to how they should be cared for if they are to give good service.

This is a most important point, because incorrect treatment will ruin them (or any other accumulator) in a few months, whereas a little care will result in years of satisfactory service.

The biggest enemy of accumulators is sulphate. This substance (really lead sulphate) is formed on both plates whenever the battery is discharged and is a perfectly normal part of the discharge cycle. It will not cause any harm, provided two important points are observed: (1) The battery should be put on charge within a few hours of it being discharged; and (2) the battery should NEVER be over-discharged.

SULPHATE HARDENS

If either of these points are ignored, the sulphate will harden to the point where it cannot be converted back to the active materials for the positive and negative plates respectively. When this happens, the battery is said to be sulphated and is eventually rendered useless.

The easiest way to sulphate a battery is to carefully charge it after use—then put it on the shelf and forget about it for about two months. It is not generally realised that all accumulators discharge of their own accord and that a battery—initially fully charged—left unused for even a few weeks will collect an appreciable amount of sulphate which may be very difficult to eliminate.

One way of avoiding this condition would be to charge the battery at regular intervals, say, once a week, making the charge just long enough to make good the battery's internal losses and to recover whatever sulphate has been formed.

A better method is never to let the sulphate form (except when deliberately discharged), and this can be done by means of what is called a trickle charge. The purpose of a trickle charge is to charge the battery at a rate which will exactly balance its own internal losses, thus preventing any chemical change and ensuring that the battery is always fully charged and ready for use.

CORRECT RATE

In the case of a conventional accumulator this charge rate may be determined experimentally by observing the minimum rate required to maintain normal gravity over a period. In the case of the dry accumulator we cannot take gravity readings, but we can control the rate fairly accurately by observing the voltage and current figures and comparing them with those already compiled for standard "wet" types.

The best indication is the voltage across the battery, and this should be between 2.15 and 2.2 volts per cell. At this voltage the battery will normally take such current as it requires to make good its own losses and this will vary with the age and condition of the battery.

As a typical example, a battery should draw between .25 and 1 pc of the normal eight-hour charge rate. In the case of the VPT7/4 the eight-hour charge rate is .5 amp (500 mA), and 1 pc of this is 5mA.

The procedure to be adopted, therefore, is to immediately charge the battery after use at the recommended rate (.5 amp for the 7/4) and, when fully charged, reduce the charge to the trickle rate, and maintain this continuously until the battery is used again.

In making the above checks it is important that the volt meter be accurate to within 1 or 2 pc for best results. The ammeter is not quite so critical.

When the battery is being charged at the normal rate there may be some doubt as to when it is fully charged, once again due to the impossibility of taking gravity readings.

This condition may also be checked by means of voltage readings, the point where the voltage ceases to rise being regarded as the fully-charged condition. It is also usual for this voltage to be somewhere near 2.5 volts per cell, though it varies with the rate of charge. However, a voltage in excess of this would indicate too high a rate for the end of charge condition.

A simple battery charger, quite capable of coping with a battery of this size, is not difficult to make and details of a suitable type were given in the June, 1952, issue of Radio and Hobbies. The rectifiers used were purchased for a few shillings each from disposals, having originally been used in a telephone relay panel. There have been many ratings issued for these units, but experience has shown that they will easily carry 100 mA when used in charges of this kind.

In an emergency the battery can be charged from a six-volt car battery using a four ohm, three-watt resistor in series to limit the current to a safe value. This will give more than 500 mA when the battery is flat, but somewhat less at the end of charge. This is a perfectly satisfactory arrangement.

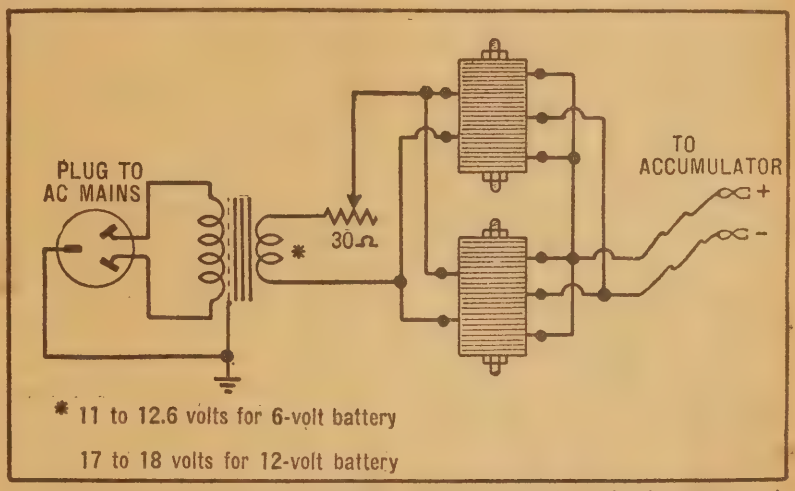
It is not advisable to charge the battery while inside the case. In spite of the fact that the cells are non-spillable, they will give off fumes while charging. These are detrimental to both the metal box and, more important, the fine wire in the transformer. Since the battery should be put on charge as soon as possible after use and left on the trickle rate until needed, it is best kept out of the case until immediately before use.

To produce the trickle rate, additional resistance could be introduced, either alone or in combination with a switch which will cut all but one of the rectifiers out of circuit.

The other enemy of accumulators is overcharge, either in rate or time, since it causes excessive gassing and consequent loss of active material from the plates. Providing the recommended rate of 500 mA is not exceeded and the charge is terminated when the voltage ceases to rise no harm will be done.

It is also necessary to "top up" the cells from time to time with distilled water to make good losses due to natural evaporation and gassing. The makers recommend that this be done after every five charges or once a month, whichever is the more frequent.

This job is most easily carried out with an eye-dropper, and the water should be added slowly, about one-half dropper at a time, until the cell gives evidence of not wanting to take any more. The packing in the cell should have the appearance of being as moist as possible without any sign of free liquid. It is better to add a little water at fairly frequent intervals, say once a week, than to add a lot at intervals of several months.



A simple charger using disposals rectifiers. Four of these should handle 500mA and a transformer voltage of nine or 10 would be required for a four volt battery.

And the question which everyone is just itching to ask is, "How many flashes will I get from a fully-charged battery?" While much depends on circumstances, the following test should prove helpful:

We set the equipment up with a disposals timer in the trigger circuit, so that the tube was flashed once every minute, at maximum rating. The battery was fully charged and the set-up allowed to run until the battery voltage at the end of the charging cycle dropped to 3.6 volts (1.8 volts per cell).

RESULT

This occurred when the battery had delivered just on 100 flashes, so that one should be sure of at least this number. However, this was a rather more arduous test than is likely to be encountered in practice, plus the fact that the battery was new and had not been previously discharged. All accumulators need to be cycled about three times to achieve their maximum capacity. It would not be unreasonable, therefore, to expect upward of 150 flashes under ideal conditions.

OFF THE RECORD — NEWS & REVIEWS

Vladimir Horowitz, son-in-law of Toscanini and pianist extraordinary, supplies two discs for this month's reviews which are probably as good examples of his work as we are likely to hear. To my mind they display not only his wonderful powers, but also his self-inflicted limitations.

By JOHN MOYLE

THE first time I heard a Horowitz record many years ago I wondered what on earth I had struck. This man threw off the most incredible performance with the mind of a razor and fingers of steel.

Unfortunately to my way of thinking he has preserved both his ferrous qualities as the years have gone by, polished his performances, and mastered every trick, artifice and resource of the master pianist.

But despite all this, I torture myself to find out why at the end he leaves me with a feeling of mental and emotional frustration.

MOZART — Sonata No. 12 in F major (K332).

BEETHOVEN — Sonata No. 14 in C sharp Minor Op. 27 No. 2 (Moonlight) played by Vladimir Horowitz. HMV BLP 1014.

RACHMANINOFF — Concerto No. 3 in D minor No. 3. Played by Vladimir Horowitz and the RCA Symphony Orchestra conducted by Fritz Reiner. HMV ALP 1017.

Both these works are heard a great deal, being featured alike by concert artists and students of various degrees. The Mozart is a simple example of economical and charming piano composition — the Beethoven is a beautiful and contrasting sonata in which we see the composer turning from his earlier influences and moving toward his later and more important work.

COLOSSAL TECHNIQUE

To both of these, Horowitz applies his colossal technique, his dexterity, and that dynamic control which flows from his fingers with an effortless and almost contemptuous ease.

So impeccable is his pianistic performance that one could literally spend hours analysing it, vainly searching for some effect which was not perfectly done.

But when it is ended, I feel that I have heard Horowitz, but I have not heard Mozart or Beethoven. The fellow just didn't give me time. It was all over before I realised it was done, and the music behind the music had been passed over. Pianistically it was nearly miraculous, but musically it left no lasting impression.

The last time I heard the Moonlight it was played by Gieseking. I heard the mind of the man make the music sound like something new, as it always must do under a great performance. Horowitz gave me no clue at all as to what he had in his mind, if any.

I liked the Rachmaninoff much better. It is a beautiful concerto, no matter how slighting the pedants may be, and one could not cavill at whole slabs of it as produced by all.

But here again, the temptation to hammer out any passage which could be whipped along in a dazzling interlude shattered the very atmosphere which real musicionship had created.

I do not object to the firm handling which characterises the entire performance, for too many spoil Rachmaninoff by drooling over him, but I don't want to hear Horowitz or anyone else showing off in the middle of it.

At the same time I am sure that his admirers will greet both records with joy and gusto. They do every justice to the pianist, the orchestra and the conductor. I doubt whether there is a better recording of the concerto at the present time.

Technically both discs are safe and satisfactory average, but not up to the best examples of their type. Both showed a few crackles.

MOZART — Divertimento in E Flat Major for String Trio K563. Played by Jean Pougnet (violin), Federick Riddle (Viola) and Anthony Pini (cello). Westminster WL 5191.

In every way this is a superb record. I would have to search so hard to fault it that I just couldn't be bothered.

This was the only trio of its kind which Mozart wrote, and one of only two trios in all. Musically it is entirely delightful. It has six movements, each one a little piece of perfection in its own way. Such a long chamber work is unusual, but each movement can stand on its own for that matter, if you could bear to switch off once the record begins. It has the added virtue of being novel because rarely performed, and familiar with the marks of Mozart's genius.

SUPERB PLAYING

The performance is also superb, as one would expect from such a trio of fine players. It is inseparable from the recording, however, for to a large degree one makes the other.

Westminster still seem to hold a clear lead in chamber music recordings, and with a comparatively easy combination of three strings the engineers have established a really fine balance. It is a particularly forward record, but with only three players there is no sign of oppression. Only an amazingly realistic bite to the bows, an exhilarating sharp line to the attack, and a clear outline to the masterly interplay of strings. Under such a deadly ear any fault in intonation of timing would be mercilessly exposed, but there is none. The violin tone is always sharp but not edgy, and Pini's fine cello is a delight to hear.

Technically it is again superb. Its range is full, but it sounds as clean on the last groove as on the first. The surface noise is inaudible — a very fine pressing to delight you wide-range fiends.

You have yourself to blame if you miss this one.

WAGNER — "Isolde! Tristan! Gelieber!" from Act II, Scene II of "Tristan and Isolde". Sung by Martha Moedl, Wolfgang Windgassen and Johanna Blatter with the City of Berlin City Opera Orchestra conducted by Arthur Rother. Radiola-Telefunken LSK 7017.

Only an LP record could give us music like this, for to leave one's chair every few minutes to change discs would be an intolerable intrusion on some of Wagner's loveliest work. Even the hardiest anti-Wagner would find it hard not to acclaim the beautiful quality of the music in this extremely fine recording.

Several things stand out — firstly the absolute silence of the surface which, when played at normal room volume, makes not the slightest sound, and secondly the fine quality of the singing, to say nothing of the orchestra.

A FINE EXPONENT

The performers are well known and seasoned exponents, and there can be few finer voices than Martha Moedl singing Isolde today.

Her quality and control are wellnigh faultless.

General balance could scarcely be bettered. The essential fusion of vocalists and orchestra are ensured by just the right degree of remoteness and reverberation which avoid completely that objectionable air of studio performance.

One can only congratulate both Radiola and Telefunken on an example of how it should be done both musically and technically.

DUKAS — The Sorcerer's Apprentice. MARCEL POOST — Allegro Symphonique. DEBUSSY — Dance (arr. Ravel) played by the Grand Symphony Orchestra of the Belgian National Radio Institute Brussels conducted by Franz Andre. Radiola-Telefunken LS 6016.

ANDRE GRETRY — Cephale et Procris. Rameau — Platee (Orchestral Suite).

BERLIOZ — Will-o-the-Wisps Dance. Chabrier — March Joyeuse. Played by the same orchestra and conductor. Radiola-Telefunken LS 6011.

The tale of the Apprentice who got into trouble working magic in his master's absence is now a firmly established concert piece. It is played here brilliantly, and with plenty of life and program. The exhilarating Allegro by the modern Belgian composer Marcel Poost is new to me, but it's first rate music written in brilliant style, calculated to stir the most phlegmatic audience. It is in great contrast to the Ravel-orchestrated Debussy Danse.

The coupling is however, admirably chosen, and you will search in vain for a dull movement in this really beautiful record. The orchestra plays with most refreshing verve,

brilliant and sensitive, and there is obviously nothing stodgy about the conductor.

The only fault I have with the recording is a strange muddiness under pressure where it seems to lose its otherwise good definition. Maybe it has something to do with the reverberation plus microphone placement. Otherwise it is extremely brilliant, with first-class range and a surface quite devoid of any blemish.

The second disc is an intriguing miniature concert of well known and representative French music meriting comment very similar to the first. The performances are first rate, and have an elan which is refreshingly different. I advise you to hear them both.

DEBUSSY — Children's Corner Suite. Played by the Symphony Orchestra of the Belgian National Radio, Brussels, conducted by Franz Andre. Radiola-Telefunken VE 9010.

MOZART — Eine Kleine Nachtmusik. Played by the Bamberg Symphony Orchestra conducted by Joseph Keilberth. Radiola-Telefunken VE 9028.

These 78 rpm augmented playing records are quite a thing for those who haven't gone over to microgrooves. Their extended time is obtained by variable grooving, by using more grooves per inch, and, I suspect, careful tailoring of the dynamic range, or maybe it just sounds a bit less in comparison with the best LP records.

LOW SURFACE

I was quite impressed by the amount which has been cut into these records, as well as the smooth nature of the very low surface noise, which allowed me to play them most successfully using LP curves in the absence of any guidance.

Particularly in the Debussy record, the range is quite wide, and we hear cymbals and triangles which are generally lost in 78's. They also play quite well near the centre despite their somewhat dangerous looking proximity to the label.

The Children's Corner Suite was originally written for the piano but has been arranged for orchestra. The Golliwog's Cakewalk may help to identify it for those not familiar with the whole work. It is played attractively despite some hum which I suspect is not in my motor, and which might show up on wide range machines. This is an orchestra worth watching, and I'm sure this disc could be very popular, particularly as normal 78's would need at least four sides.

The same applies in general to the Eine Kleine which is rather more remote in recording, and hasn't the frequency range of the Debussy. But apart from the very competent performance, it will be very hard to resist the appeal of only one turnover from start to finish.

BEETHOVEN—SYMPHONY IN C MINOR OPUS 67. Played by the Vienna Symphony Orchestra conducted by Otto Klemperer. Festival-Vox CFR12-122.

This is a good clean record and there is very little in the score that I did not hear. That, in fact, is my main criticism of it. No doubt the Vienna players are doing just as they are told — the trouble is that they rather sound like it. There is little if any reverberation behind them, and this symphony needs just the right amount to make it sound as big as it is.

Klemperer has it played meticulously, with no unwelcome liberties. But somehow he never quite succeeds in getting it going. This is a symphony which needs drive, whereas Klemperer literally conducts us through it. The third movement is a good example of what I mean. It descends almost into a coma in preparation for the last movement. A contrast here is in order, but we must also have the suppressed excitement to hint of what is to come.

MORE IMPACT

If you don't object to this extremely steady approach you will like this record, for otherwise it isn't bad. I'd just like to hear more of that "force and impact" which the program notes speak about. And a live studio, please!

Frequency range is fairly good and the surface is low.

VIVALDI—Bassoon Concerto in D Minor played by Henri Helaerts and the Suisse Romande Orchestra conducted by Ernest Ansermet.

MARCELLO—Oboe Concerto in C Minor played by Roger Reversy and the Suisse Romande Orchestra conducted by Ernest Ansermet. Decca LX 3100.

We recognise immediately the brilliant work of the Suisse Orchestra, and that beautiful definition I have remarked upon many times. The bass is full and solid, and the well defined top allows the full character of all instruments to be heard at all times. It is particularly good for both the oboe and the bassoon whose individual color depends so much on harmonic content.

Frankly I prefer the oboe of Roger Reversy to the more emasculated tones of Goossens. The sharp edge of the oboe is part of its greatest charm, and I feel somewhat regretful when I hear it dampened to the character of an unhappy kind of flute. The recording loses nothing of it on this disc.

Both Marcello and Vivaldi were Venetians of about the same period and both works are written in the graceful and stylised manner of the time.

This is a very fine record musically and technically. The surface is extremely good.

VAUGHAN WILLIAMS—Fantasia on a Theme by Tallis. ELGAR — Wand of Youth Suite No. 2, Op 1b. Played by the BBC Symphony Orchestra conducted by Sir Malcolm Sargent. HMV BLP 1019.

A very sound and acceptable performance representing two British composers who saw their country and people through very different eyes. Sargent achieves that beautifully broad, flowing front of the Tallis music which moves over one in a solid wall of sound. Elgar's Suite was a product of that strongly romantic dream world which one can see so often woven into almost all his work. It is frankly programmatic, and contains some of the composer's most attractive musical interludes.

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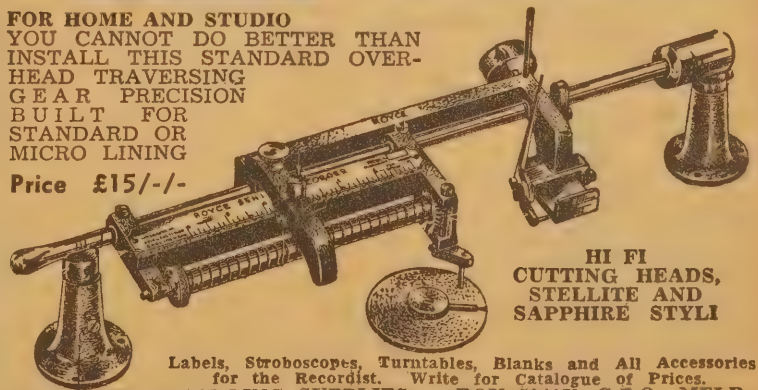

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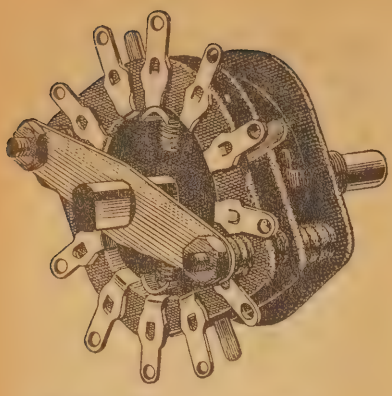

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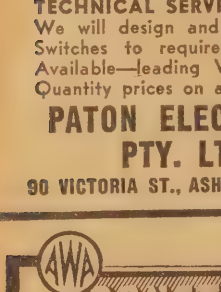

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RECORD NEWS FROM ABROAD

By DISCOBOLUS

Activity in the record world continues to grow, and there is no sign that the pace is slackening and as usual, opera is well to the fore.

COMING right on top of the HMV release in England in April of the opera Cavalleria Rusticana is another version by Decca.

The new issue is on a set of two 12in LP, which is quite a saving over the three-disc set from EMI. Decca have used the fourth side for an operatic recital by Mario del Monaco, who is one of the principals in the opera itself. This still does not seem to be the ideal way to sell a work of this length, but those who do not want Pagliacci as well will probably settle for the Decca recording.

BACKHAUS & BEETHOVEN

From Decca there is also a Backhaus recording of three Beethoven Sonatas, a Debussy disc by Ansermet and the Suisse Romande, and two Bach Cantatas, Nos. 51 and 202, by Suzanne Danco and the Stuttgart Chamber Orchestra. Friedrich Gulda plays the Chopin Piano Concerto No. 1 with the London Philharmonic and Sir Adrian Boult, and Clifford Curzon has some more Schumann to offer.

HMV have announced a complete recording of Fidelio, with Furtwangler and the Vienna Philharmonic. Soloists include Alfred Poell, Sena Jurinac and Rudolf Schock. The same company have a third recording of La Boutique Fantasque, with the Philharmonia Orchestra, but reports state that it will not replace the Decca 12in issued a couple of years ago.

Menuhin and the Berlin Phil., under Furtwangler, are featured in the Mendelssohn Violin Concerto, and Wanda Landowska plays the Goldberg Variations of Bach.

The Sydney Symphony Orchestra recording of the Beethoven 2nd Symphony has at last been released in England, along with a 78 of their Danse Macabre. Both have been very well received.

COLUMBIA'S LIST

Columbia have a good deal in their May list, which starts off with the Tales of Hoffman, from Paris, and Faure's Requiem. Paul Kletzki and the Philharmonia play Rosamunde, and George Weldon and the London Symphony the dances "Nell Gwyn", Henry VIII and Merrie England. Larry Adler and the London Symphony play the Harmonica Concerto by Benjamin, and Vaughan Williams' Romance for Harmonica, Strings and Pianoforte.

American Westminster have an English-made record of Berlioz Symphonie Fantastique, with Hermann Schershen and the London Symphony, but so far NIXA have not released it in England. Les Preludes and other Liszt tone poems are in the same batch, but have not been issued in London.

I am not aware who is behind the Record Corporation of America, whose USA label is Allegro, but this company is building up a substantial catalogue very quickly. In the past, their records have been mainly "mood music"—the cocktail-time background numbers—and the selling price has been very low. From time to time they have advertised symphonies and the like, but in all few people have bothered to notice them.

Now, out of the blue, comes a list of new releases which is colossal by anybody's standards. Among almost 40 LP's in one month recently are the following: Brahms Symphonies 1-4, Beethoven Symphonies 1-9, plus the "Jena" Symphony, and by Wagner, Das Rheingold (three records), Die Walkure (five records) Siegfried (five records) and Gotterdammerung (six records). All these are, of course, 12in discs, and sell for just under three dollars each. They also have a number of 10in for a dollar and a half, consisting of everything from Handel and Bach, through Stravinsky and Bartok to Dizzy Gillespie and Duke Ellington.

Releases on this scale have not been seen in England, and seldom if ever in America either.

EP RELEASES

Kostelanetz and Columbia are continuing to cater for the person who likes operatic music, but can't stand the singing. Their latest is an orchestral performance of Carmen. Previously, Kostelanetz had done the same thing with La Boheme, evidently with some success.

EMI in England have added considerably to their list of Extended-Play 45's, using both the Columbia and HMV labels. They seem good value for the money. On Columbia there are the Galliera-Rossini Overtures, two to a disc, for 11/3, and Orb and Sceptre (the Coronation March), 1953, coupled with Portsmouth Point for 15/11. Finlandia now fits on to one side of an EP by HMV, with a Strauss waltz on the reverse, also for a reasonable price.

Technically, the records are said to be of excellent quality, and it is difficult to see how Decca can maintain the prices of their Medium-Play at the present high level, and still keep their sales figure high.

Still on the subject of Decca, they are about to take over distribution of the French Ducretet-Thomson label, whose latest records range from early seventeenth century to Beethoven and beyond.

LATEST move by the record companies to combat the dust problem with microgroove discs is to provide a special plastic sheath inside the normal cardboard envelope. The sheath does more than just provide a smooth internal surface. It is made of a specially selected plastic which, by reason of electrostatic attraction, tends to cling to the surface of the disc as it is slipped into the envelope. Take full advantage of this precaution by not leaving discs lie around unprotected and by keeping the turntable itself free of dust.

A FINAL WORD ON CURVES

After reading all we have to publish this month about record curves, I thought I'd throw yet a few more facts into the ring about how equipment variations can write their plus and minus on what you think you are getting. It all helps to keep our feet on the earth.

MY comments and tests concern the stylus which performs the important function of tracing the record groove. At the moment, the job of doing this perfectly is one of the most vital matters which can concern us, for wide-range equipment will show up any failure of the tip very badly by the addition of peaks and distortion.

Mostly it is the top end which goes first, and it is precisely this end where effects can be most distressing.

So I set up some gear consisting of the new amplifier equipment described in this issue, a motor and Decca test record, an output meter and oscilloscope to check waveforms, and a good quality magnetic pick-up, the performance of which is well known to me, and good enough to put it in the top bracket.

STYLUS TEST

This enabled me to check the performance of the gear from the record onwards, which was my primary object, but it also gave me a chance to see what happened when different styli were used in different stages of wear.

Altogether I have tested nine different styli in a similar manner, all brand new, and by tabulating the results, been able to observe the differences between them. In addition, I had a number of worn ones which were subjected to similar tests.

To go through the whole set of figures would be rather tedious, particularly as it would be necessary to interpret their meaning as well. But there are certain conclusions which are borne out by them, which I would summarise as follows:

After tests with nine brand new styli it was found that variations in stylus diameter without wear can—

1. Vary top response several db at high frequencies particularly near resonance.
2. Vary bass response by a lesser amount.
3. Cause severe distortion through groove chatter at high frequencies.
4. Vary noise level from surface.
5. Vary output in general.

Variations in damping can cause all the above in different degrees.

WORN STYLUS

After about 50 playings wear is enough to—

1. Reduce top response several db particularly near resonance (a variation of 5 db was observed).
2. Produce severe harmonic distortion at spots in response including middle range where effect is most easily appreciated.
3. Require extra weight on the head to reduce distortion, which is never completely eliminated and severe wear probably caused.

After 100 or so playings, stylus is bad enough to be useless on wide range machines, and only tolerable with severe top cut.

For compensation curves to be even reasonably accurate it is necessary to—

1. Use a stylus permanent enough to stand long periods without wear.
2. Check the stylus for response when fitting.
3. Compensate pick-up for variations from normal response.
4. Be prepared to experience variations in response due to lack of uniformity in grooves from record to record, from wear in stamping, and from wear in use.
5. Ensure that damping does not age.

EFFECT ON CURVES

If, therefore, we accept this type of evidence, we must realise that such variations as applied to fixed compensation curves might well change the top roll-off characteristics from one standard to another, a change which is progressive and non-predictable. The only way to reduce the risk to reasonable proportions is to follow the recommendations about the permanent styli. There is evidence that most pick-up makers are realising that diamond is the only material at the moment good enough for reasonable permanency.

The availability of diamond points at the moment isn't very good although almost every pick-up manufacturer seems to be paying some attention to them. In our small way we are endeavoring to interest all concerned in thinking in terms of diamonds, because I'm sure we are not the only ones who have observed the inadequacy of sapphires particularly for wide range equipment.

Even for less demanding cases, the more permanent point is an advantage, for a worn stylus must result in greater record wear even if the first signs of it are not so obvious in listening.

On a record changer, for instance, where often its life is fairly grim, a more durable point would be a good thing.

TRUST IN CURVES

Diamonds of course are more costly than sapphires, but larger production would inevitably reduce the price. If they were ever made on the scale of the sapphires, they could unquestionably be cheaper. To a large extent, therefore, progress to better styli will depend upon the demand of users for them, and firms which handle pick-ups will soon sit up and take notice if repeated requests for them were received.

As it is, we notice a larger number of advertisements in which diamond points are mentioned, and anything which will accelerate their free availability would be a good thing. In the meantime, you must be prepared to change your stylus quite often if you play many records and want top performance all the time.

Its not unreasonable in a "final word" if there can ever be such a thing, to attempt some assessment of

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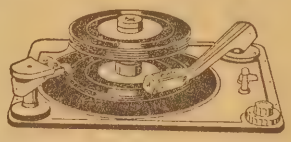

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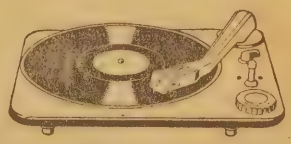

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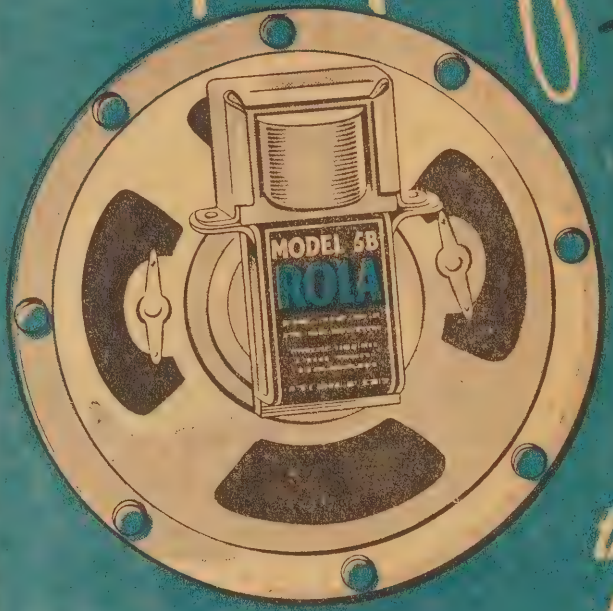

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AND ALL LEADING WHOLESALERS.

s playback position in the light of e large amount of material we have llected together in this issue. Why oduce an amplifier capable of commodating many of these curves one proceeds to produce equal idence that it is foolish to worry out them?

But it isn't really foolish, for anyng is better than to wander among host of knobs which do this and at, without any guidance at all. nether one approaches the matter om an examination of playback rves as such, or by providing facles for altering roll-offs and curve pes, I am all for the principle of rting from somewhere, making y overriding variations plus or nus this point.

I have listened to many discussions out equalisation, and have often en convinced that, in the bandying out of terms, and rigid acceptance standards, many of the particints just didn't realise how much or w little these were to be trusted, exactly what additional design ctors could operate to cause them be varied.

For this reason, I feel the attempt analyse these factors will enable to tread on much firmer ground nen adjusting equipment for best sults, and what is more important, ll allow us to return to certain andards for purposes of reference nen we have cause to do so.

In the table of curves printed bew, you will see that this idea is plied in the preliminary comment pplied with them, indicating that compiler has come to the same nclusion. It is without doubt a fact at the right adjustment is the one u like best, because it is your ear and your musical reaction which is most important to you.

To sit doggedly listening to a record played back on the right curve, assuring yourself that all is the best possible best, when all the time you are itching for a little more bass, is just foolish. But as the variants are in the main likely to those from something which the recorder hoped to achieve — we can't say more than that — it is logical to start from there.

I am quite sure that you will find your operation of controls much more satisfactory, and much more intelligent, if you proceed on this basis, than if you were let loose with a set of infinitely variable settings which you wangled until you became sick of the whole business. When wandering in a wood, any pathway is better than no guide.

Finally, some information taken from the American "High Fidelity" gives the latest on compensation curves. Please read the advice in the preliminary paragraph, and remember that, in any case, there is a plus and minus design figure on all curves of 2 pc—enough to make some of them almost overlap.

PS. I forgot to mention that even with a good stylus, a lightweight pickup is extremely sensitive to weight. A few grammes difference can alter response several db at 10 Kc. No stiff bearings! PPS. With apologies to him, I have a friend who had no use for his extra bass cut control until he acquired a Klipshorn, a special bass loading device designed primarily for electronic organs. I could probably think up a PPPS, but maybe that is enough for one month.

One-knob equalisers should be set for correct bass equalisation according to the table below; if the treble is not correct for the record, then the treble tone control should be used to adjust further. Either boost or cut may be required, according to the equaliser curve available and the rolloff needed for the record: remember that COL, LP, ORIG. LP, NAB, and LON rolloff is 16 db, and LON, ORTHO (RCA), and AES rolloff is about 12 db. Remember also that the proper setting is that which sounds best to the ear, regardless of what it is supposed to be. It's perfectly legitimate to use bass and treble tone controls to make the music sound right — that's what they are intended for!

LABEL	TURN-OVER	ROLL-OFF	LABEL	TURN-OVER	ROLL-OFF
Angel	NAB	AES	Esoteric	NAB	AES
Atlantic (a)	NAB	NAB	Folkways (most)	629 (b)	16 db (c)
American Recording Soc.	NAB	Ortho (d)	Good-Time Jazz	AES	AES
Bartok	629 (b)	16 db (c)	Haydn Society	COL	NAB
Blue Note Jazz	AES	AES	London	COL	LON (d)
Boston	COL	NAB	Lyrichord, new (e)	629 (b)	16 db (c)
Caedmon	629 (b)	11 db (g)	Mercury	AES	AES
Canyon	AES	AES	M-G-M	NAB	AES
Capitol	AES	AES	Oceanic	COL	NAB
Capitol-Cetra	AES	AES	Philharmonia	AES	AES
Cetra-Soria	COL	NAB	Polymusic	NAB	NAB
Collosseum	AES	AES	RCA Victor	Ortho (f)	Ortho (d)
Columbia	COL	NAB	Remington	NAB	NAB
Concert Hall	AES	AES	Tempo	NAB	Ortho (d)
Contemporary	AES	AES	Urania (most)	COL	NAB
Cook Lab. (a)	NAB	AES	Urania (some)	AES	AES
Decca	COL	NAB	Vanguard—Bach Guild	COL	NAB
EMS	AES	AES	Vox	COL	NAB
Elektra	629 (b)	16 db (c)	Westminster, old	NAB (h)	NAB (h)
Epic	COL	NAB	Westminster, new	COL	AES

(a) Binaural records produced by this label are recorded to NAB standards, on the outside band. On the inside band, NAB is used for low frequencies, but the treble is recorded flat, without pre-emphasis.
(b) NAB position on equaliser is close match.
(c) NAB position on equaliser is close match.
(d) Use LON position on equaliser, or AES with slight treble cut.
(e) Some older records of this label were recorded to COL curve, others to AES.
(f) Very close to NAB on lows.
(g) Very close to AES on highs; boost treble slightly.
(h) Unless jacket indicates AES.

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SHORT-WAVE NOTES BY ART CUSHEN

150-MILLION POTENTIAL LISTENERS

Interesting figures from the data compiled by the United States State Department show that some 200-million radios are at present in use throughout the world.

THE huge potential audience of some 150-million radio listeners tuned to short-wave stations has thrown new light on the increased power and additional coverage many stations are trying to accomplish

Radio Station HCJB, Quito, which will soon be using 100Kw is one station which hopes to take advantage of this huge listening audience for the missionary broadcasts. In releasing these details, they show just how effective short-wave radio can be in European and Iron Curtain countries, and, to a lesser extent, in the Far Eastern communist countries, in their efforts to bring Christian broadcasts to all countries.

AUSTRALIA'S LOW FIGURES

One of the most surprising figures shows that Australia has only 18 pc of the 2,230,000 receivers equipped with short-wave bands, yet the sister Dominion, New Zealand, has only 520,000 receivers, but some 70 pc tune the short-wave bands, which means in fact that New Zealand has more short-wave receivers than Australia.

Some of the other figures prove our past suggestions of the high percentage of listeners in the tropical countries, where short-wave broadcasts for local reception are used very extensively.

Sweden has always been considered as one of the leading radio-conscious countries, and the figures show that over 95 pc of the listeners in that country are short-wave listeners, which is borne out more fully by the many active organisations in Sweden. Without a doubt, Sweden has more shortwave listening clubs than any other country.

Taking the main areas, we find that the Far East has only 12 pc short-wave listeners out of 14-million receivers, Latin America some 51 pc of 8,382,400 listeners, Africa, some 74 pc tune short-wave of the 806,000, while in Europe, in the Western Europe area, some 78 pc, and in Eastern Europe 81 pc, in a total of 63-million receivers.

Although jamming and deliberate interference at present hinder much of the enjoyment of the reception, we can hope for the day in the not-too-distant future when the air will be cleared of deliberate interference and we can tune without this annoyance on the short-wave bands.

New Japanese Commercial

JAPAN'S first commercial short-wave station, JOZ, has been heard with test broadcasts on 3925Kc from after 7.0 pm to after 10.0 pm. We mentioned in the last issue that JOZ was due to commence operation in June, using a 5000W transmitter and on the 3925 and 6095 Kc frequencies.

The station is operated by Nippon Tanpa Hoso, in Tokio, and from announcements it appears they also have a broadcast band frequency. Signals are fairly good, though slightly weaker than the nearby Indonesian station, YDH2 Semerang, on 3945 Kc. Commercial radio in Japan is now covered by some 23 broadcast band stations, ranging from 500 to 10,000W, but JOZ and JOZ2 are the first to operate on short-wave.

RADIO JAPAN

RADIO Japan's schedule for the winter period, May 1st to August 31st, includes the use of two new frequency-call signs, JOA4, 11705Kc, and JOB4, 15235Kc. The complete schedule is:—

On JOA6 (15135), JOB4 (11780), 3.0-4.0 pm (to North America), 5.0-6.0 pm (Hawaii), 9.0-10.0 am (South America), 7.0-8.0 pm (Australia, New Zealand).

On JOA4 (11705), JOB3 (9675), 8.30-10.30 pm (North and Central China), 3.30-4.30 am (Near East), 5.0-8.0 am (Europe). On JOA4 (11705), JOB5 (15235), midnight-1.0 am (South China), 10.45-11.45 pm (Philippines, Indonesia), 1.0-2.0 am (Indo-China, Thailand, Burma), 2.15-3.15 am (India, Pakistan).

THE VOA AT SEA

COURIER'S transmissions from the sea-borne relay base, now at Salonika, Greece, is the subject of an inquiry from LAC V. C. Kelly, of RAAF, Pearce. WA Courier operates from the 5800-ton vessel. Formerly the Courier was stationed at Rhodes, but is now at Salonika, where it is understood the antenna, formerly held aloft by balloons, has been replaced by a land antenna system, and this fed from the ship, which is anchored at Salonika.

THE LATEST NEW LATIN-AMERICANS

OVER the past few months we have reported many new Latin-American stations being in operation, and most of these have been heard in North America. June and July find reception from the South and Central American area at its best during the afternoons so we are listing these new stations in order of frequency, and will be pleased to hear from readers who hear any of these new broadcasters.

K'cycles	Location and slogan	Times reported
4825	HJHC "Radio Naino" Pasto, Colombia	Closes 2.30pm.
5980	HJDO Cali Colombia "Radio Libertad"	Logged 1.15pm.
6035	HRTL Tela, Honduras "Radio Tela"	Closes 2.00pm.
6101	—— Guatemala City, "Radio Philips"	Sign off 3.10pm.
6165	ZYR57, Sao Paulo, Brazil "Radio Cultura"	Heard 2.25pm.
6235	—— Esmeralda, Ecuador "Radio Ibis"	Sign off 2.30pm.
9440	CP38 La Paz, Bolivia "La Cruz de Sur"	Sign off 1.30pm.
9485	4VC Port au Prince, Haiti "Radio Commerce"	English sign off 3.12pm.
9490	OAX6H Tacna, Peru "Radio Tacna"	Closes 2.00pm.
9595	ZYN22 Bahia, Brazil "Radio Cultura da Bahia"	Sign off 1.00pm.
9600	HJTC Bogota, Colombia, "Radio Militar"	Schedule not known
9685	—— Sao Paulo, Brazil "Radio Gazeta"	Sign off 2.00pm.
9735	ZPA4 Asuncion, Paraguay "Radio Stentor"	Sign off 1.00pm.

FLASHES FROM EVERYWHERE

CHILE'S CE619, in Santiago, operated b Radio Corporacion Chilena de Broac casting, is now signing off at 4.0 pm, tw hours later than the normal sign-off. Th station operates CE619 (6190), and CE15 (15150), both using 5000W, and they are o the air 9.25 pm-4.0 pm. Some years ag verification was by a large colored pe nant, and if readers are lucky to obta this verification, it is one of the mo colorful additions to the verification co lection we have seen. The full addre of CE619 is Casilla de Correos, No. 244 Santiago. The signal on 6190Kc is fai but some side interference from GR (6195) is troublesome.

The Voice of International Evangelisr Tangiers, is a new religious station, fi anced by free-will contributions. The st tion uses 2500W and operates on 7305K The schedule is: Week-days 6.0-7.0 ar Sunday 11.0 pm-midnight. The broadcas are in Spanish, French and Portugues and in English, 6.30-7.0 am, Tuesda Thursday, Saturday. Additional broac casts in German and Czech are also plar ned, reports World Radio Handbook bull tin. The broadcasts on this station hav been heard in New Zealand, but signa are only weak, and jamming interferenc is severe.

NOTES for the next issues close on June 5th, July 10th at 212 Earn Street, Invercargill, N.Z All times Eastern Australian Standard Time.

DAMASCUS' transmissions on short wave include the use of 7235Kc in the 41 band, which has been heard at fa strength at 6.30 am. The program is i French and includes several Arabic musi cal numbers. Signals are slightly weake than Paris, which is also broadcasting i Arabic on 7240Kc. Damascus operates a follows: In Arabic, 2.0-5.0 pm, 9.30-11. pm, 3.0-8.0 am, on 6165Kc, 20Kw, 1.0-4 am, 5.30-8.0 am, also on 6165Kc, wit 7500W; in Hebrew and German, midnight 1.0 am, on 6165Kc, 20Kw; French, 5.30-8. pm, 11.0 pm-midnight, 7145Kc, 7500W; 6.30 7.30 am, on 7235Kc, 20Kw; English, 8.0 9.30 pm, 7145Kc, 7500W; 7.30-8.30 am 7235Kc, 20Kw; Arabic and English, 12.45 1.45 am, 15395Kc, 20Kw; Turkish, 4.15-5.1 am, 6165Kc, 20Kw; Arabic, Spanish, Por tuguese, 10.0 am-noon, 11915, 9555Kc, 20Kw

RADIO CEYLON'S commercial servic has made a frequency change for it 25M band outlet, and now uses 11770K when they open at 11.30 am, and a rela of the BBC news is broadcast at noor The 7190Kc frequency is also announce as being in parallel. Radio Ceylon's 60M band outlet on 4870Kc is also being re ceived, with fair signals, at 2.0 am.

INTERNATIONAL RED CROSS conduct ed test broadcasts on 7210Kc during th weekend April 22-26th, from the trans mitters loaned to them by the Swis Broadcasting Corporation. We are sorr we didn't get prior notice of this tes to inform readers, but details of th broadcast only arrived the day the broad cast commenced. The tests are carrie out once each year over 7210Kc to fin out world-wide coverage and to keep th frequency "active". In the event of an emergency the Red Cross can then begi broadcasting with some knowledge of th reception of their signals in various part of the world. We have asked the chief o the broadcasting section of the Interna tional Committee of the Red Cross, Mr Georges Kuhne, to advise us next year when they will again test the transmit ters, in ample time to notify DX listen ers in this area. Red Cross are very anxious to hear from anyone who heard these test broadcasts, and a report to th International Red Cross, Geneva, would be appreciated by them.

THE HAM BANDS WITH BILL MOORE

DX-minded amateurs in various parts of the world have been active in promoting and participating in expeditions to countries where amateur stations do not normally operate. The amateur bands become extremely crowded when these stations are operating, but only a few make the exclusive contact.

AMATEUR RADIO DX EXPEDITIONS are becoming increasingly popular ıese days. In the last few years there ave been many, including trips to the alapagos Islands,, Monaco, Andorra, Rio e Oro and St. Pierre.

DX stations throughout the world have een geared up to ensure a contact with ıese outlandish countries.

The DX expedition for April was the ourney of WONWX to Clipperton Island. The island is a French possession some 000 miles west of Mexico.

It was reported that this particular exedition was financed by a well-known ımerican communications receiver manuacturing concern, assisted by a number f prominent DX stations.

The expedition was handicapped by very ough seas which firstly delayed the nitial landing on the island, and secondly ıfter a day's operation further petrol upplies could not be brought ashore.

The lack of petrol caused a further loss f 24 hours of operating time.

Using the call sign F08AJ they operated n all bands from 3.5 to 28 Mc/s.

Competition, as was expected was very ɔeen, and to make a contact with an exɔedition so well advertised one would ıave to be rather fortunate.

The usual "dogpiles" were noted, at one stage the portion of 14 Mc band 14,000 to 14,100 was a squealing mass of signals.

It was impossible to decide where F08AJ was really operating. F08AC appeared at one stage and the hordes decended upon the frequency calling FO8AJ.

The operator of F08AJ was very efficient, working new stations every few seconds. He would not contact stations on his own frequency — an excellent procedure — only working with stations 15 Kc/s higher in frequency.

A number of W stations complained that the expedition contacted only leading DX stations over there.

After spending many hours standing by, they were very discontented especially when F08AJ was operating on the 3.5 Mc band.

A number of Australian stations made contact on the 14 Mc band during the afternoon. Apparently American stations faded out on the island allowing contacts with stations farther east. VK2QL was in contact on the first afternoon at 1500 hrs EAST.

Expeditions by amateurs to remote prefixes to boost the countries list of DX stations have come to stay, the main problem soon will be to find new prefixes and locations from which to operate.

WIRELESS INSTITUTE ACTIVITIES

The Victorian Division as the headquarters division of the WIA, appointed the following members to the Federal Executive for 1954-1955:—

Federal President — Bill Gronow, VK3WG.

Federal Vice-President — Harry Kinnear, VK3KN.

Federal Secretary — Max Hull, VK3ZS.

Further officers were appointed by the above FE members.

Federal Treasurer—Rick Ewin, VK3AGC.

Federal Assistant Secretary — John Rice-Oxley, VK3AKO.

Federal Publicity Officer — George Glover, VK3AG.

The NSW Divisional Council of the WIA for 1954-55 remains as for the previous year, nominations for council were restricted to sitting members. The main office bearers will be elected from the following councillors:—

George Bruce, VK2GT, Horry Oakes, VK2FA, Jim Corbin, VK2YC, Don Pollard, VK2ASW, Bill Lewis, VK2YB, Roy Pearce VK2IV, Vaughan Wilson, VK2VW.

The new secretary for the division — the most arduous position in amateur affairs in each State — is Harry Hickin, VK2ACH, who takes over the position from Dud Millen, VK2LQ. To be precise he takes over from Dud and his wife who is VK2MI. They both however will assist during the year if required. Their work during the past year was greatly appreciated by members.

The various officials for the division will be elected during May.

UHF SECTION

The annual meeting of the NSW Division's UHF section was held on May 7 and the following officers were elected for the year 1954-55:

President—Perc Healy, VK2APQ. Vice-President—Bob Winch, VK2OA. Secretary—John Miller, VK2ANF. Assistant Secretary — Horry Lapthorne, VK2HL. The management committee comprises the following amateurs, Roy Hart, VK2HO, Harry Solomons, VK2AJZ and Horry Lapthorne, VK2HL.

NSW and visiting UHF enthusiasts are invited to attend the monthly meetings held at Science House, Gloucester St., Sydney, on the second Friday in each month.

Ted Whiting, VK2ACD, has been appointed the NSW Divisional sub-editor for Amateur Radio. He was for a number of years short-wave correspondent for this magazine. Ted will undoubtedly appreciate the co-operation of the various NSW zone correspondents and amateurs in that State to ensure the steady flow of suitable articles for the magazine. His address is 16 Louden St., Five Dock.

The circulation manager is Bob Roach, VK2ARI, who is responsible for the compilation of membership lists and will ensure all members obtain their copy of the magazine.

URUNGA CONVENTION

The fifth annual convention of the NSW WIA's North Coast and Tablelands zone was held at Urunga over Easter and proved to be the usual outstanding success from any angle — social and technical.

It is an event when amateurs from many places within the State meet, plus always a few interstate visitors. One overseas call appeared this year, that of Frank VR4AE, who is to become a VK4. VK4GG and VK4PR also attended.

NSW amateurs included VK2EA, 2FH, 2PA, 2QV, 2UC, 2WQ, 2XO, 2YC, 2AAW, 2ABP, 2ABT, 2ACU, 2ADN, 2AEU, 2AHH, 2AHM, 2AJS, 2AKR, 2AOR, 2ABP, 2AQO, 2ASO, 2ASW, 2AVG, 2AWG, 2AWH, 2AXZ, associates Snow McAuley, Norm Dash, Jack Vardy (ex VK2JK), Les Bright plus many XYL's, YL's, and juniors.

The prize list was extensive and distribution to winners of events was as follows:—

Gerry Challender Memorial Trophy:

First prize.—A replica of the cup provided by the WIA, and a £5 open order on John Martin Pty., Ltd.—winner Bill Grant VK2AWG.

Second prize.—0 to 100 MA, meter donated by John Martin Pty., Ltd. Won by Ted Gabriel, VK2AVG.

144 Mc transmitter hunt.—Replica of Gleeson Bros. Trophy provided by the WIA together with a type QQO4/20 valve donated by Philips Electrical Industries Pty., Ltd.—Winner Lieth Martin, VK2EA.

Urunga scramble: First prize.—Replica of the URD Cup given by the WIA and a £3 open order on United Radio Distributors Pty. Ltd.—Won by Bill Grant, VK2AWG.

Second prize.—Open order for £1 on URD—winner Jack Lindsay, VK2AKR.

A special prize of an order of £1 on URD for the best miles per watt performance—Bill Grant, VK2AWG, for a contact with ZL1CA using 7½ watts.

Lucky registration number.—A Ronette microphone donated by Laurence and Hanson Electrical Pty. Ltd., was won by VK2ACU, Rod Pike, of Coonamble.

A prize for the furthest distance travelled was won by Jeff Whyte, VK2AHM, who travelled 1035 miles from Wentworth. Jeff received a 2E26 valve donated by Amalgamated Wireless (Aust.) Ltd.

Blue Aked, VK2AEU, received an 803 for the best respectable story.

OTHER PRIZES

Other prizes were donated by Ted Gabriel, VK2AVG, and Don Pollard, VK2ASW.

Evening entertainment was in the capable hands of Jack Gerard, VK2ADN, who produced some excellent artists from Coffs Harbor.

The standard of these shows especially the Sunday evening concert was very high, unequalled at WIA conventions.

The previous evening was spent at Crief, 2XO's "Do Me" shack.

Films selected by Jack, VK2ADN, were screened by Ted Hamey, color slides by VK2AXZ, VR4AE and VK2XO were also shown. The usual hospitality was dispensed.

A feature of the convention were the discussion groups formed on many occasions to debate the problems of amateurs. They often centred around the State President Jim Corbin, VK2YC, and covered a multitude of subjects from regulations to flood emergency working.

The North Coast of NSW the most vulnerable point for flood damage in Australia, has been the centre of extended amateur emergency working, and the opportunity was taken by those in attendance to discuss all aspects of this work. The result should be a clearer appreciation of the most effective methods for future activity.

The successful completion of the convention depended on the voluntary work of many amateurs.

Noel Hanson, VK2AHH, North Coast zone officer, was in charge, and VK's 2FH, 2JK, 2TG, 2XO and XYL, 2YC, 2ACU and XYL, 2ADN, 2AOR, 2APB, 2ASW and 2AVG also assisted in various ways.

The generosity of the many trophy donors was greatly appreciated.

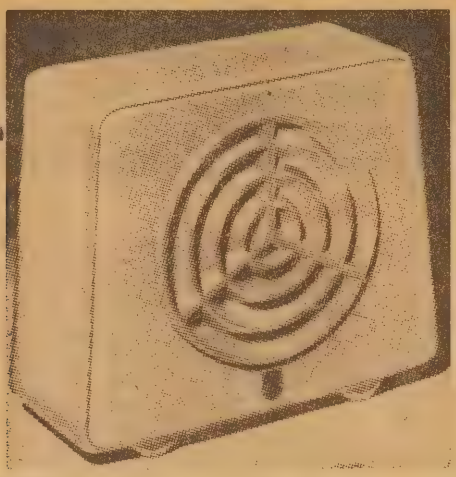
Next year's event will be under the managership of Ted Gabriel, VK2AVG, who will shortly become a resident of Coffs Harbor, and either Ted or Noel VK2AHH are QRX for suggestions.

WIA BROADCASTS

It would appear that quite an unnecessary amount of interference is being caused to WIA official broadcasts on Sunday mornings, most of it unwittingly, not due to any real lack of co-operation but rather to propagation conditions. For example, take any 7146 Kc/s broadcast in a State where an alternate signal is not provided on the 3.5 Mc/s band, quite a number of stations within certain areas will often experience difficulty in receiving the B/c.

This particularly applies to stations close by in the skip area, and interstate stations at the same time are running at S9. Unless these latter stations are well clear of the WIA frequency they cause quite serious interference.

HERE IS THE FULL RANGE OF AEGIS EXTENSION



SPEAKERS

Available From Your Usual Retailer

SP5 JUNIOR: Round plastic cabinet 2in deep, 7in circular with louvred front. Circular feet in contrasting colours. First quality 5in speaker less transformer. Terminal block fitted. Voice coil outlet 3 ohms. In walnut and natural. Price 55/-.

SP6 MINOR: Attractive round moulded cabinet 4in deep, 7in circular with louvred front and rear. Circular feet in contrasting colours. 6in speaker less transformer (3.7 ohms input impedance). Terminal block supplied to facilitate connection of wiring. In black, walnut, natural, pastels blue, green and pink. Price: 85/-.

SP6 Minor Cabinet only, less speaker and terminal block. Black, walnut, natural, 44/9: Red, pastels blue, green, and pink, 50/-.

SP6/A MINOR: With output transformer only. Black, walnut, natural, 119/-.

SP6/B MINOR: With output transformer only. Red, pastels blue, green and pink, 122/3.

SP7 SENIOR (illus. above): Features plastic cabinet with the new Spinner-type front. Measures 11½in wide, 10¼in high (tapered), 4½in deep with 7in speaker less transformer. Volume control fitted with special knob in centre of grille. Voice coil outlet 3.7 ohms. In walnut and natural. Price: 123/-.

Same as above less Volume Control, 107/-.

SP8 SENIOR (illus. above): De-luxe model same as above but 10½in high (top up) and featuring Senior De-Luxe 8in speaker less transformer. Terminal block fitted. In walnut and natural. Price: 141/6.

SP8 Senior (same as above) less Volume Control, 124/-.

SP6/C MINOR: With volume control only. Black, walnut, natural, 140/-.

SP6/D MINOR: With volume control only. Red, pastels blue, green and pink, 143/-.

SP6/E MINOR: With output transformer and volume control. Black, walnut, natural 150/3.

SP6/F MINOR: With output transformer and volume control. Red, pastels blue, green and pink, 153/6.

All prices quoted are plus Sales Tax and in W.A. and Nth. Qld. prices slightly higher.

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"MAGNEGRAPH" TAPE DECKS

Manufactured by Boosey Hawkes Ltd., England

★ The "Magnegraph" Tape Deck is a precision mechanism, and when used in conjunction with a suitable amplifier it provides faultless recordings and playback of music and speech.

★ The "Magnegraph" has a recording time of 70 minutes per loading, made possible by the use of a twin recording head.

★ A direct reading calibrated scale shows the exact amount of tape that has been used. A fast rewind speed enables the user to run back to any portion of the tape in a matter of seconds.

★ The top panel of the "Magnegraph" Tape Deck has a baked enamel cream finish, which is handsomely engraved in red. Provision has been made on the top panel to mount the record/play switch, volume control, input and output jacks.

★ The "Magnegraph" deck is supplied ready to operate, and is complete in every detail, including—main control switch and knob, level indicator, mains indicator. A schematic circuit of the "Magnegraph" amplifier is supplied which includes chassis layout, etc.

PRICE **£31/10/-**
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Demonstrations and amplifier kit sets available at

EXCELTRON RADIO CO. —FA2665

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AUSTRALIAN AGENTS: T. H. MAY & CO. PTY. LTD., 16 YOUNG ST., SYDNEY. BU5412.

Amateurs in the past have co-operated extremely well in keeping WIA channels clear at B/c times. It would help even further if stations kept at least 15 Kc/s clear of the frequency.

This would allow for the occasional roll over and the paralysing signal that cause difficulty in receiving the S4 or S5 transmission that has sometimes to be copied.

With winter conditions at hand the ZL QRM problem is also with us. In poor coverage areas they, too, have been causing some interference. They, too, will co-operate when they appreciate their signals are now audible in the eastern States all day long on the 7 Mc band.

ORDINARY AERIALS

It is becoming increasingly difficult for the CW station with normal Antenna equipment to contact the rarer DX stations. The current poor propagation conditions, too, don't improve matters for these stations, and only stations with beams are consistently contacting the better DX, except perhaps the rarer stations close at hand.

In the peak DX years 1947-1949 it was possible to rapidly tally 100 countries on CW.

This was using only a dipole and in some cases amateurs achieved such a total using telephony.

Today to compete with the beam users is impossible. Whether this will change with improved conditions and the variation in sunspot cycle remains to be proved. The cover of W stations with their kilowatts and elements will cause much interference, and the weaker signals will have to battle against great odds.

DX expeditions are not an easy mark for dipole users as so many stronger stations are generally standing by.

There does not seem much future for the old Zepp or similar Antenna in the DX race, but with the aid of some skip and good operating, a few new countries may still be added to the total as conditions improve.

DX AND PERSONAL

WARREN CLARKE, VK2ASM, has for some time now been operating on the 7 and 3.5 Mc bands from the Princess Juliana Hospital, Turramurra. Using only a few watts to a Type A Mark 3 his power is restricted by reason of some 30 broadcast receivers around and about the ward. Space for a short antenna only is available, and his signal by reason of these facts is often down. He would appreciate any calls.

Warren expects to be immobile for some six months yet, when he will return to his old Dee Why address.

ZP6BC was heard on a number of occasions on 7030 Kc on CW. Late in April he was well surrounded by anxious W stations. He was generally audible about 2000 hours east. An unusual 7 Mc CW signal was XE2LA heard on various frequencies about the same time. Few Mexicans are ever heard on CW; they operate practically exclusively on telephony.

KF3AB toward the North Pole in the Artic was another unusual prefix. He was contacted by VK2QL and gave an apparently satisfactory QTH. The KL7's have been often the strongest signals in the evenings of 7 Mc so the KF3 should be legitimate.

7mc MOBILE

Mobile operation on the lower bands is becoming increasingly popular these days, some 7 Mc mobile signals comparing favorably with fixed stations. The Sunday trip provides enjoyment for the family plus some interesting operating.

Bill Storer, VK1EG, who will operate from the Australian base in Antarctica, had not appeared on the amateur bands up to the end of April. He will be off the air for a further period as it was announced on the ABC on April 30 that he would be accompanying two other expedition members on a journey into Mc-Robertson Land and would be away from the main base for some time.

About the same time it was announced in the Press that diesel generating sets had been now set up to supply electric light and power for the base. Bill will now have power for his equipment and it is hoped he can find time on his return. Many operators are awaiting anxiously his initial appearance on the amateur bands.

VERSATILE MICROPHONES

AWA RONETTE

Model HM7

- For TAPE RECORDING, compact, light and handy to hold.
- For ADDRESSES, SPEECHES &c., on table stand or floor pedestal.
- For SILENT FILMS, LANTERN SLIDE LECTURES and those hundred and one occasions when a convenient, efficient and dependable microphone is needed.

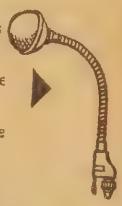
PRICE £7/3/6

Study the economy of the following prices.

O-88 for fixed bracket mounts £8/12//-.

O-88F with flexible mount cable plug, £14/15/6.

O-88U for stand mount and cable plug, £10/5/6.



Models R474 £31/6/6.
R572 £18/19/9.
R572/L £22/4/9.
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GS210 £9/3/6.
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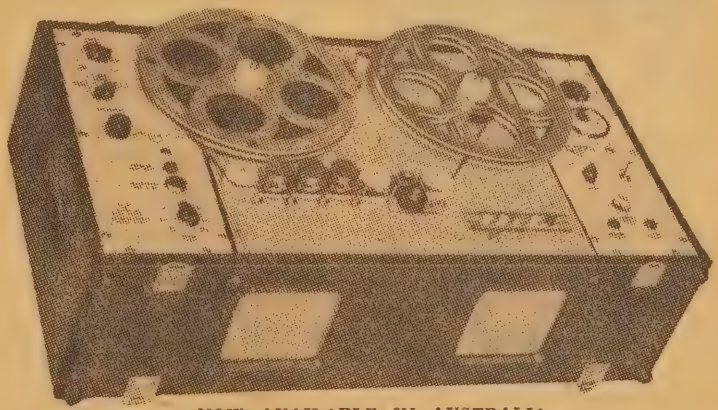
The C.J.R. BRADMATIC TAPE RECORDER



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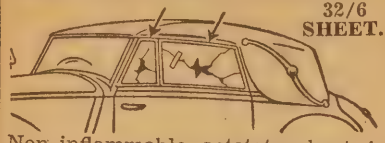
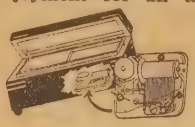
32/6 SHEET.



Non-inflammable actetate sheet is recommended for all types of side curtain. Sheets are 20 thousandths of 1 inch thick. Size of sheet, 24in x 52in. Can be sewn or cemented into frames.

Now you can make your own music box with these Swiss music units. They can be fitted to any type of box, doll, jug, teddy bears, etc. Hours of enjoyment for all the family.



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Tunes available: Lili Marlene, Jingle Bells, Blue Danube, Harry Lyme Theme, Wedding March, The Merry Widow, Happy Birthday, Annie Laurie, How Dry We Are, Roll Out The Barrel.

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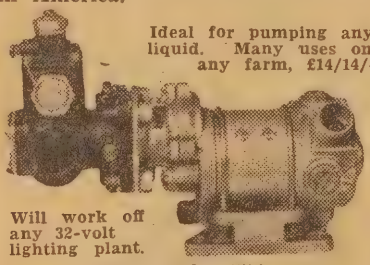
IDEAL FOR MOTOR CYCLISTS AND ALL OUTDOOR WORKERS.

BRAND NEW, 15/- EACH.

Aircraft 24 volt Motor complete with 400 gal. per hour Pump. Made in America.



Ideal for pumping any liquid. Many uses on any farm, £14/14/-

Will work off any 32-volt lighting plant.

Pump only, 55/-.

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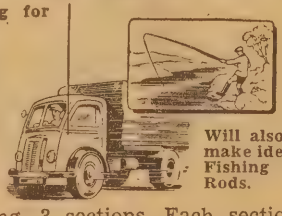

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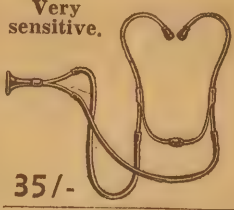
Ideal for Testing Engines, etc.

Very sensitive.



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Ideal for School Bands. Never before at this amazing price.

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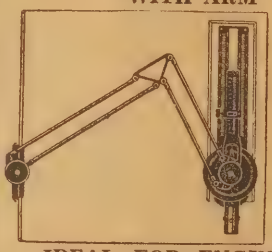

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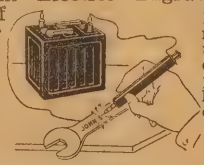

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Engraves anything in metal.

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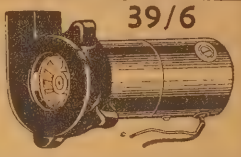

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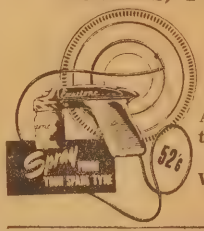

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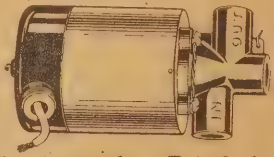

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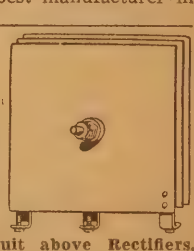

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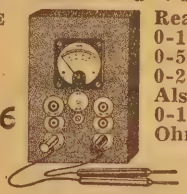

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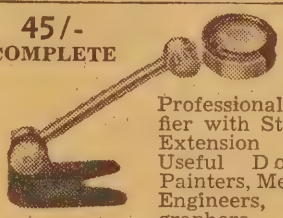

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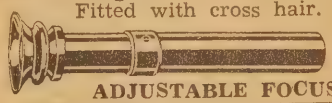

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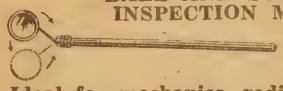

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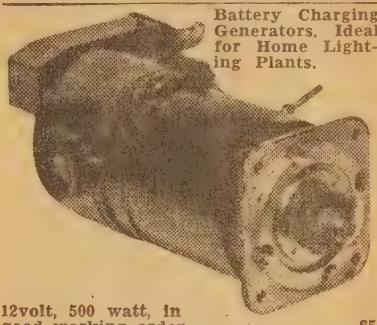

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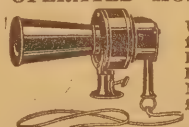

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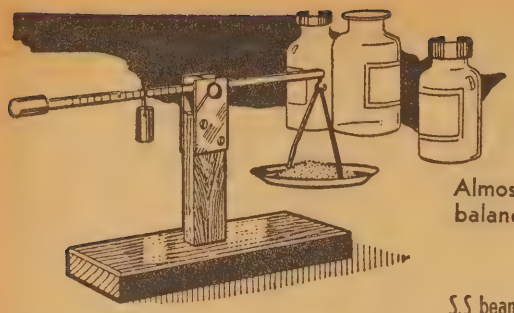


Simple Beam Balance

FOR WORKSHOP OR DARKROOM

Almost any workshop or darkroom at some time requires the use of a balance. This article tells how you may make one from easy-to-get materials.

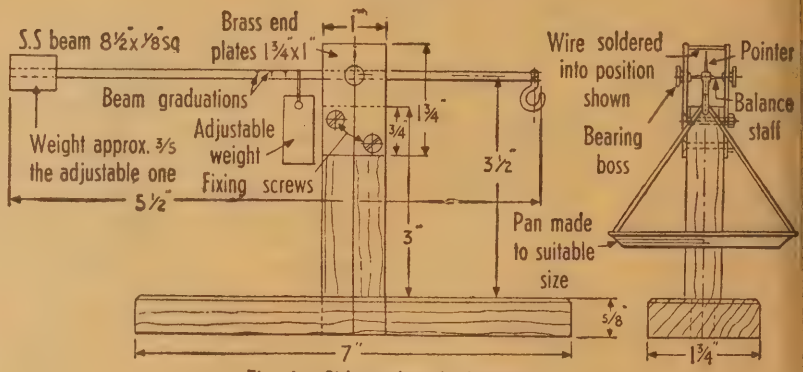
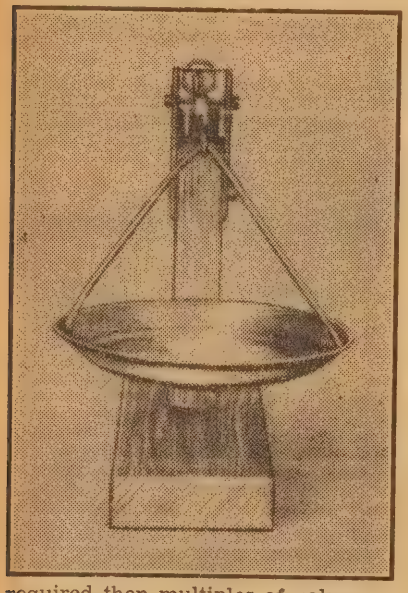
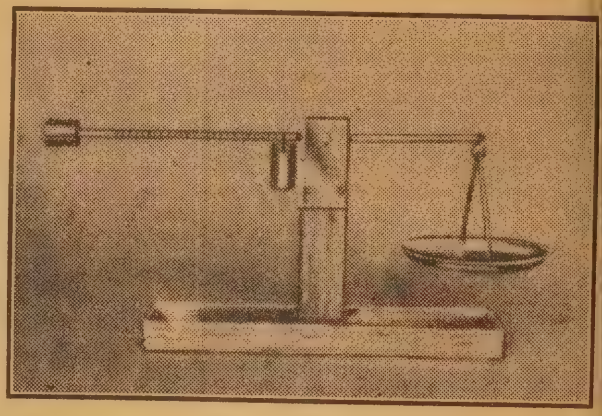


Fig. 1.—Side and end elevations.

THE balance was originally designed for weighing photographic chemicals, but it can no doubt be used for other purposes. It is small, accurate to a reasonable degree and, what is an asset to non-technical minds, it is extremely simple to make. The balance weighs small quantities up to 25 grams in stages of 1 gram, or up to 1oz in ¼oz. If higher values are required then multiples of values up to 25 grams, or 1oz, are easily obtained.



(Left). End view showing the side bearing plates and pan.



(Right). A view of the completed balance showing the simple stand and mountings.

The fulcrum is the most important part of any balance and, to overcome the difficulty of friction, the balance staff and pivots of an old alarm clock were used. The clock balance staff was mounted between end plates on a vertical wooden column. The thickness of the column depends on the distance between the original clock end plates. In fact, the original clock end plates can be used if so desired. The clock pivots can either be screwed into the balance end plates or soldered into holes drilled in them (see Fig. 1).

THE BEAM

The beam is 8½in long of 1/8in sq silver steel. A hole is drilled through it 3in from one end to take the balance staff, and another at right angles to take the pointer, which is made from part of an old gramophone needle. Fig. 2 shows the pointer and balance staff soldered in position.

One end of the beam has a hole drilled through it to take a 1/8in diameter steel hook which supports a copper or an aluminium pan. The pan is 3in in diameter and its supporting wire is 2in above the rim of the pan. The pan, of course, can be of any size or shape, and if it is made smaller in diameter the distance between the point of suspension and fulcrum can be decreased.

At the other end of the beam a brass counterweight is forced on. The adjustable weight is of the same material and diameter. The exact weight of the balance weights depends on the weight of the pan. The counterweight is about three-fifths the weight of the adjustable one. The moving weight is held on to the beam by a wire which fits into slots in the beam top.

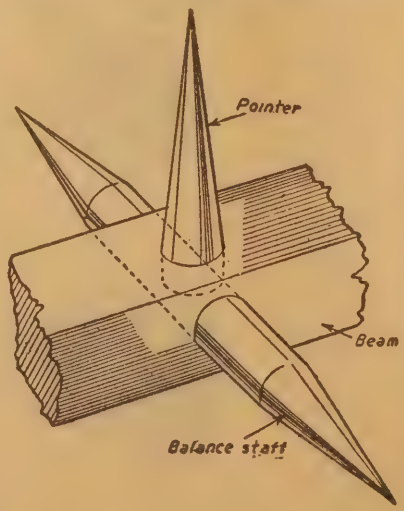


Fig. 2.—Details of the balance staff and pointer.

The base and column are made of wood. The 3in high column is screwed into a base 1¾in x 7in. The brass end plates are 1¾in x 1in and can either be bolted through or screwed into the wood.

CALIBRATION

With the balance assembled bring the moving weight near to the control column. When the beam is in a horizontal position cut a slot in the top of the bar to take the suspension wire of the adjustable weight. Also, solder in a wire across the top of the end plates in line with the pointer needle. On the two left-hand vertical faces of the beam, stick white paper for the scale and mark off the zero point already obtained. The scale is graduated by putting appropriate weights on the pan and then marking off the scale. The scale shown gives the 5 grams in red marks, and 1 gram values in blue. On the other side of the beam the scale is marked off in ¼oz.

In the absence of weights for calibration the following weights of Australian coins will prove useful: 3d, 25 grains; 6d, 50gr.; ¼d, 90gr.; 1d, 150gr.; 2/-, 180gr.

PLAYMASTER SEVEN

(Continued from Page 35)

hich should be large enough for the mplifier and any tuner likely to be sed, the output voltage after the ter was exactly 300 with the 5V4G. ubtracting a bias of about 20 volts, is leaves us with about 280 volts ffective from cathodes to plate and reens of the output valves. This lls just nicely into ratings, and e have successfully used these alves with added output up to an ffective 300 volts, even though the akers would not publicly approve. hey are very robust and should sily withstand this small overload.

Layout, &c., should be quite bvious from the illustrations and hassis designs should be available r the amplifier by the time these ords are in print.

If the amplifier is not to be used ith a tuner, then a power supply of 0 mills rating would be adequate. would also guard against the total oltage being too high due to the wer drain. If 125 mill components re used, the rectifier could well be 5Y3 which would reduce the effecve plate voltage to nearer 250 volts.

When assembling an amplifier of his size on a small chassis, it is lmost impossible to avoid unwanted ffects due to the proximity of comonents. A little thought is needed therefore to reduce them. A case in point is the output transformer which, being large, is susceptible to hum pick-up from the power transformer and even the filter choke, which are also somewhat bulky.

Although the hum voltage is small, it can be heard, if coupling exists, even with all valves removed, and power connected to the transformer. The cure is to mount the two transformers with their cores oriented for minimum pick-up.

TEST FOR HUM

There is room to rotate the output transformer on the chassis. Before mounting it in place, connect the voice coil to the speaker, and listening right at the cone, find the angle at which the hum disappears. It could be mounted right next to the power transformer if the cores were exactly at right angles to each other, as in the Playmaster No. 2, but in this case the spot might be too critical, remembering the different makes of transformers which might be involved. It seems better to separate them as much as possible, and choose the angle at which the coupled hum disappears. We performed this operation after the photographs had been taken.

For the really fussy, there is a tiny speck of hum liable to be picked up by coupling between the power transformer and the first 6AU6. Changing over the positions of the input socket and this valve reduced the effect by increasing the spacing, but even so some valve shielding will still be needed, and the valve becomes rather vulnerable to damage, due to its exposed position on the corner of the chassis.

Ordinary valve shields are not suitable, the metal must be iron or steel. We made a good one from a short section of metal conduit. Best effect of all was a steel plate between the transformer and the valve line-up, which wiped it completely. A couple of layers of tin-plate might do the trick as an improvised valve shield.

By this time, the hum level with input shorted and the control unit gain wide open should be as low or lower than the valve hiss itself. For all practical purposes the outfit is completely humless.

For best results, the amplifier should be used with a high-grade loudspeaker, properly housed in a vented enclosure or some other suitable baffling medium. The length of the connecting lead to the speaker is not critical within reason, and we have used 20ft of ordinary plastic-covered AC twin flex for the purpose. It is in fact recommended for lengths such as these, as being better than light gauge wires.

SPEAKER LEADS

If the speaker is located some distace from the amplifier, this lead may be run under the floor boards, or even installed as several runs terminating in suitable sockets if the speaker is used at more than one spot. The conenction to the Control Unit may be several feet in length, enabling the latter to be mounted in the most convenient position for operating. The heavier amplifier is generally placed on the floor of its cabinet or somewhere else out of the way.

While on this matter of residual hum, we might mention a point which, although obvious in itself, has caused us and our readers a bit of bother.

It is very difficult to make equipment using heavy power transformers which does not vibrate mechanically a small amount in sympathy with the mains frequency.

Normally, an amplifier is mounted, in some kind of cabinet, very probably on a shelf at the bottom. Even if the shelf is very solid, these vibrations from the transformer are transmitted to the shelf and the cabinet, producing a slight but audible hum.

The way in which this source of hum can deceive one is remarkable. According to the acoustics of the room, it can appear to come from places other than the cabinet, and even from the floor itself on which naturally the cabinet stands.

POOR POSITION

In one case, it was found that the spot selected for the speaker cabinet was one at which the 50-cycle hum frequency was quite noticeable, due probably to the shape of the room and other factors affecting its acoustics. The speaker was being blamed for the trouble when actually it was reasonably hum-free.

It is a good idea, therefore, to check on the positioning of the heavy amplifier in the cabinet to eliminate this acoustical hum.

Placing the amplifier near one of the sides will help to avoid vibration of the shelf, which, in any case, should be of heavy wood or well braced.

A layer of some material which will damp out mechanical vibration is a good thing, and you may happen on a piece of sheet as used to carry out sound insulation. Even a layer of felt will help, or some squares of rubber from an old inner tube. A little experiment will enable you to completely eliminate any danger of hum from this source.

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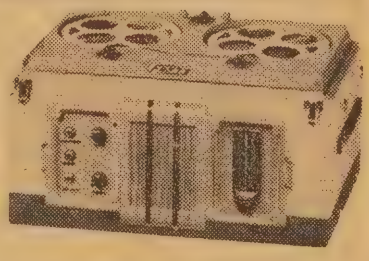

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Here's Your Answer Ton

(Continued from Page 69)

bias is often to be preferred fo amplifiers operating in class A be cause it tends to be self regulating If the supply voltage goes up fo some reason the valve tends to drav more current, the bias developec across the resistor is greater. Thi acts against the tendency for ai increase in plate current and th system reaches equilibrium with a lower plate current than if fixec bias had been used.

The same goes for valves of the same type with slightly differen characteristics due to age or mino manufacturing imperfections. Witl cathode bias they tend to reach equilibrium nearer the optimum cur rent than with fixed bias.

The bias resistor must be by passed with a large value capacitor so that the voltage across it will not change appreciably as the plate current goes through the excursions dictated by the grid. The average plate current is the same as the plate current without signal.

However, if the amplifier is operated in other than class A the average plate current will be greater than the standing plate current. If a bias resistor is calculated on the basis of the standing plate current, the bias applied to the valve will be greater than necessary after a few cycles with the result that the power output of the stage will suffer.

It would require a fabulously large bypass capacitor to minimise this change of bias with signal.

The only solution is to provide a source of bias independent of the stage itself or "fixed bias" as it is generally known. This may be from a battery. Alternatively, a transformer, rectifier and filter may be used if it is desired to avoid an expendable device.

Direct Reading Meters

(Continued from Page 55)

same as with lower-resistance non-electronic voltmeters.

However, it is appropriate to call attention here, to a few precautions which should be observed to protect the meter and insure continued accuracy of the instrument.

1. When uncertainty exists as to the approximate level of a voltage, use the highest voltage scale first. Then, switch down successively to each lower range until deflection is obtained in the upper portion of the scale.

2. Switch the voltmeter to its highest range during idle periods, and also close the microammeter short-circuiting switch.

3. Always close the short-circuiting switch when the instrument is being transported. This provides efficient damping of the meter and will prevent mechanical damage due to shaking and vibration.

4. Do not expose an ultra-high-resistance voltmeter to magnetic fields, moisture, or corrosive fumes for long periods of time.

5. Keep the panel area around the input terminals scrupulously clean of dust, grease and moisture.

YOUR SIGNAL TRACER

(Continued from Page 47)

racer were both switched to short wave and the test repeated, with the same results.

This left two possibilities. Either the oscillator section was not working at all or it was working on a frequency not covered by the tracer. However, the signal tracer had established that the trouble was definitely in the oscillator section.

The junction between the oscillator grid return resistor and the cathode of the converter was broken and the multimeter switched to the 1 mA range. Had the oscillator been working normally we would have expected a reading of about .2 mA, but in this case there was no reading at all.

We were satisfied that the oscillator was not working, but the tunable signals were still unexplained.

The next logical step was to make a routine check around the oscillator circuit with a multimeter, and in doing so we checked the oscillator plate voltage at the valve pin (125V, a little on the low side but not sufficient to explain its non-operation). Then, with the set switched off, we checked the values of the oscillator grid return and plate dropping resistors, as well as the continuity of the coils.

MULTIMETER CHECKS

When checking continuity of the tuned winding of the oscillator coil it was noted that the resistance between the top of the winding and earth was very low.

A shorted trimmer, perhaps!

The multimeter was moved to the terminal of the trimmer and, sure enough, the resistance across it measured practically zero. But wait! Before unsoldering the trimmer, perhaps it was somewhere else. Turn the wave change switch to short wave. The short disappeared.

It could only be between the pole of the switch and the grid coupling capacitor or between the stator plates of the tuning gang and earth. A few seconds and a couple of leads unsoldered led us to the stator plates of the tuning capacitor.

After that it was simply a job for visual inspection and we found the trouble after a closer look at the tuning capacitor. A blob of solder had become firmly wedged between the stator plates and a rivet holding together the frame of the capacitor. Why it had not caused trouble before we can't explain.

The set worked normally with the oscillator stage restored to operation, but we noticed that there were a number of whistles at different parts of the dial. With the oscillator section of the gang temporarily shorted out with a screwdriver these whistles turned out to be the stations we could hear before.

There is really not much that can be done about the whistles. They are a function of the design of the set and the fact that the signal input from the test aerial is fairly high. The whistles disappeared when a smaller aerial was connected, and as the customer had not complained about them we decided to leave the matter rest. A complete cure may have involved a new aerial coil of better design and it is unlikely that the customer would want to pay the cost of the coil and the additional time required to instal it.

(Continued on Page 111)

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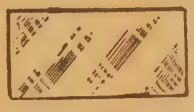

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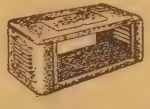
2 x 4, 2/4; 3 x 5, 2/4; 4 x 6, 3/-.



INSTRUMENT CASES.

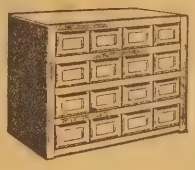
Lift-up Lid.

15¼ x 7 x 8¼ deep. Suits chassis 11 x 8. Price 61/9, add postage.

METAL CASES.

"A" 5 x 5 x 4	deep ..	15/9
"B" 7 x 6 x 4½	deep ..	17/3
"C" 9 x 7 x 5½	deep ..	18/9

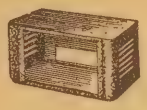
Add postage.



UTILITY METAL CABINET.

One of the most popular cabinets made. No workshop or den is complete without them. For all those small parts. A place for every part. All the 16 drawers have provision for fitting identification cards. Just right size, 12 x 9 x 5½in deep. Attractively finished in grey baked enamel. OUR PRICE **48/-**

Postage: Vic. 2/9; other States 5/-.



METAL CASE

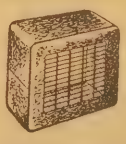
(Louvred Sides).

Model 206. Ventilated type. Black wrinkled finish, loose front panel. Size 11 x 5½ x 7in high. Panel size 9 x 7. Suits chassis 8 x 5. Our Price 26/9. Add postage.

AMPLIFIER CASES.

Best quality 18G metal. Consists of base chassis, chassis cover and plate, sloping front. Black wrinkled finish. Small size, 12 x 9 x 7½ deep. Price 52/6. Med. size, 18 x 10 x 10. Price 67/6.

Please add postage.



SPEAKER BOX.

The most attractive model on the market. Suits 8in speaker. Black wrinkled finish. Price 24/-.

Please add postage.

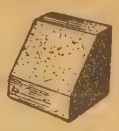
METER SHUNTS.

We make shunts to suit all meters. Those listed are to suit meters of 100 ohm internal resistance.

10, 25, 50, 100, 250 m/A. 14.8 and 166.6 ohms. Tolerance to .1%. Our price 6/9 each. Post free.

SUNBEAM SHAVEMASTER

The world's finest electric shaver £14. Post Free.



SLOPING FRONT INSTRUMENT CASE.

Model 202. 9 x 6¼ x 8in high. Front panel 9 x 7. Finished in black wrinkled enamel.

Our price 32/6.

Add postage.

ENAMELLED WIRE.

Specially wound on neat wooden spools in popular lengths. All B&S sizes.

Gauge.	100	200	300ft.
16	9/6	17/-	25/-
18	6/3	12/-	17/-
20	4/-	7/6	10/-
22	2/9	5/-	7/6
24	2/6	3/4	4/9
26 and 28		3/4	4/9

Add postage.

BRIGHT STAR CRYSTALS.

All crystals are chemically etched to ensure that the frequency once set is permanent. Tested to an accuracy of 0.01% over temperature range of 0° to + 60° centigrade. Both amateur and commercial frequencies catered for. Write direct to us for quote.

ITEMS NOT ILLUSTRATED

(but worth noting)

"Ironcore" Electric Razor Converters, either 6 or 12 volt, £8/15/-.

Potentiometers, 150K and 250K, 3/- each.

10K, 2/6 each, 1K, 1½K, 2½K, 3K, 8/- each.

Two Gang Midget Condensers, 11/6 each.

Rivets—

Midget Hollow, 3/- pkt.

Aluminium .. .. 3/- pkt.

Self Tappers—

Midget .. .. .. 3/- pkt.

Medium .. .. .. 3/- pkt.

Merlin W/W Resistors—

3W .. .. 2/3 ea.

5W .. .. 2/6 ea.

Coil Formers, 1¼, 1½, 6 pin .. .. 3/9 ea.

Morse Keys. Army type, 4/6 each.

Midget Var. Condensers, 10, 15, 25 mmfd, 8/6 ea. 35, 50 mmfd, 9/6 ea. 70, 100 mmfd, 11/6 ea.

Buron Tapped Coils, 5/6 each.

Ebro Crystal Detectors, 6/6 each.

Radio RSC Supply COMPANY

BOX 4595, G.P.O., MELBOURNE

A.C.E. RADIO

Amplification Communication Electronics

PHONE LA3845

136 VICTORIA RD. MARRICKVILLE, SYDNEY, N.S.W

EVENINGS and WEEKENDS: "KALUA", COLLAROY ST., COLLAROY — XW5956
DULWICH HILL, UNDERCLIFFE, EARLWOOD TRAM AT DOOR. STOP No. 42

Brand NEW AR8-AT5 Equipment

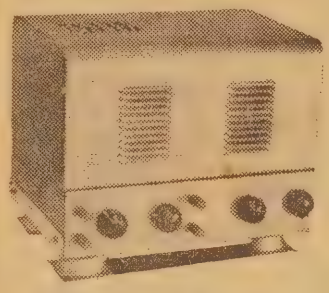
in Original Factory Tropic Proofed Cases

The Receiver, Transmitter, Aerial Coupler & Shock Mounts and Circuits

£57/10/-

Will Separate Receiver, £32/10/-; Transmitter, £25; A.C.U.; £3.

Packing FREE! for Air or Passenger Rail. Goods Rail add 10/-.



£12/19/6

AMPLIFIERS

240V A.C. only

7 Valve 10 watt £12/19/6
7 Valve 25 watt £22/17/6
7 Valve 40 watt . .. £29/17/6

240V AC HI-FI, PA Amplifier 7 Valve, 20 watt output, inputs for HI Microphone and crystal P.U. infinitely variable bass and treble boost 18 DB. Ideal for PA or tape recordings.

£26/17/6

Battery only

5 Valve 10 watt 6v .. £15/17/6
7 Valve 12 watt 12v .. £17/17/6
7 Valve 25 watt 12v .. £22/17/6

12v Battery & 240v A.C.

7 Valve 12 watt £19/17/6
7 Valve 25 watt £26/17/6

ACCESSORIES MICROPHONES, SPEAKERS GRAMO UNITS, RECORDING EQUIPMENT AT LOWEST PRICES.

ROTARY CONVERTERS

Input 24V to 32V DC

Output 240V AC 50 cycles

150 watts

£20/0/0

Heavy Duty Transformers

1500 x 1500, 750MA	10 10 0
750 x 750, 750MA	7 10 0
240/110 Auto 2.5KV	8 10 0
500 x 500, 500MA	4 10 0
265 x 265, 250MA	2 5 0
365 x 365, 150MA	2 5 0
400MA Chokes	2 10 0
150MA Chokes	1 2 6
650MA Chokes	3 10 0

American Variable Transmitting Condensers

Suitable for TO 1200V.

100 P.F. £1/1/-
60 P.F. with 50 to 1 Vernier Dial £1
30 P.F. 10/-

CERAMIC FORMERS

Ribbed 2in Diameter. With mounts 6in long 5/-

100 watt AERIAL RELAYS

Aerial changeover relays in metal case (24v). 18/6

A.W.A. 12v. Plastic Case £1

LIFE BOAT TRANSMITTERS

144 Meg., 1 Valve TX with Circuit £1/5/-

Post 2/6

WANTED

Transmitters, Receivers, Transceivers, Test Gear, Public Address Equipment. Top Prices, or will Trade-in or Exchange. State condition and price to above address.

NEW

VIBRATORS

6V. A.W.A. GAS FILLED Synchronous, Heavy Duty

15/-

SIGNAL GENERATORS PHILIPS TAIOIC

Operates from 6V or 240V A.C. 390KC to 23MEGS.

AIR TESTED PERFECT ORDER £32/10/-

A.C.E. RADIO

Amplification Communication Electronics

PHONE LA 3845

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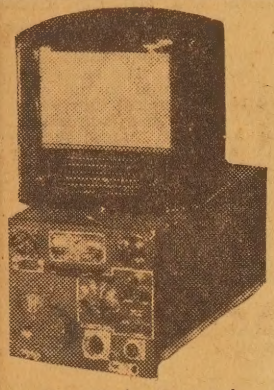
EVENINGS and WEEKENDS: "KALUA", COLLAROY ST., COLLAROY — XW5956
DULWICH HILL, UNDERCLIFFE, EARLWOOD TRAM AT DOOR. STOP No. 42



Converted, Air-tested. Complete with Power Supply and Speaker.
240V AC £29/17/6
24V DC £27/17/6
12V DC £32/17/6
32V DC £28/17/6
6V DC £37/10/-

Brand new £22/10/-

A.R.B. RECEIVERS

MADE BY R.C.A., makers of world-famous AR88

IDEAL FOR small ships, bushfire fighting units, Q5ers, &c.

FEATURES:—Coverage 195Kcs to 9.025 Mcs continuous.
Switched I.F.s 130Kcs and 915 Kcs.
6 single-ended 12 volt tubes.
Broad/sharp I.F. selectivity control with flat-topped I.F. response.
Mechanical and Electrical Bandswitching.
Directly calibrated, illuminated, 40:1 ratio dial with anti-backlash spring loading.
Neon stabilized local oscillator.
Output impedance 4000 ohms and Lo-phones.
Glass-fibre hook-up wire throughout.
Circuit supplied.

£19/10/-

NEW
COLLARO
PICK-UP
Plug-in mag. head, turntable, auto-stop.
12/6
Packed weight 6lb.

NEW
PLESSEY
Record players for 10in & 12in records. Hi fid. Decca mag. head.
£4/17/6

NEW LATEST MODEL
COLLARO
521
3-SPEED CHANGERS
78, 45, 33
WITH TWIN CRYSTAL HEADS
£15/15/0

BENDIX
BC221. FREQUENCY METERS. AIR TESTED
Original Crystal and Calibration Book
£45/0/0

NEW B.S.R. TYPE G.U.4. 3-SPEED PLAYER UNITS. TURN-OVER CRYSTAL P.U. FOR 33, 45, 78, RECORDS
£9/17/6

A.R.7. COMMUNICATION RECEIVERS

Made under licence of American National H.R.O., the A.R.7 is the finest achievement in communications field used by Australian Services. It is standard equipment with all leading airlines. 9-valve 240 A.C. operation features signal strength meter, crystal gate, 2 R.F. stages, 2 I.F. stages, noise limiter, 5 band, 140 K.C. to 25 MEGS.

AIR TESTED £47/10/-

NEW A.R.R.2 RECEIVERS

A V.H.F. receiver, 230 to 258 Megs, and 6 channels on broadcast band. Ideal conversion to carset and for hams. A ready-made, double-conversion V.H.F. receiver. 10 miniature valves, smaller than average carset.
Including photostat of circuit.
PRICE **£11/17/6**

INVERTORS

6, 12, 32 volt D.C. to 240 volt A.C. Operate your mantel radio, shaver, A.C. portable and from your car, caravan or boat batteries.

£5/17/6

ANSWERS TO CORRESPONDENTS

G.E.W. (Katoomba, NSW) writes to express appreciation of Radio and Hobbies and also make some suggestions for future articles.

A.: Our sincere thanks for your letter. We agree that there would be plenty of occasions where non-visible light could be used to advantage for the operation of photo-electric devices. In some cases the ultra-violet portion of the spectrum would be more useful than the infra-red. Data on the response characteristics of the various types of cells is available from the manufacturers. Apart from this it would be largely a matter of providing suitable optical filters. Your suggestion regarding capacitor testers and gas analysers for car engines is worth serious consideration.

A.H.D. (Kew, Vic.) suggests a means of balancing the outputs of the valves in a push-pull system. The idea is to insert a speaker voice coil between the valve cathodes and the bias resistor and adjust the drive for minimum output from the speaker.

A.: We can see no objection to the scheme unless it be that the speaker would not be sensitive enough as an indicator. The other point to watch is that the ouput circuit is loaded so that you do not damage the output valves. What you say about there being no signal at the cathode is only true for an amplifier operating in true class A conditions. For voice coils of lower than 15 ohms impedance there may be difficulty in getting sufficient sensitivity but it may be possible to use another amplifier for the purpose.

M.M.G. (Kew, Vic.) wants to know if we can tell him of a retail store in Melbourne where he can buy a kit of parts for a Radio and Hobbies set. He also enquires if "hams" are allowed to choose their own call sign.

A.: We are afraid we can only refer you to the advertisers in Radio and Hobbies, particularly those who specialise in kit sets, and suggest you choose one from these. Several of these advertisers have branches in Melbourne and details are given in their advertisements. We are glad to hear that you had so much success with the Little General and hope that you do as well in your next venture. As far as we know "ham" call signs are allotted by the PMG's Department without reference to the applicant. They may consider a specific request, however.

J.A.H. (Nedlands, WA) submits a circuit of an audio amplifier and pre-amplifier for inclusion in the Reader Built It section of the magazine.

A.: Many thanks for your letter, J.A.H. The circuit could well be of interest to our readers and we intend to keep it in mind for future publication in the appropriate section.

J.M.M. (Watsons Bay, NSW) sends a subscription for 12 months and also asks a question about the use of a choke input filter to reduce the HT voltage in his Williamson amplifier.

A.: Thanks for your subscription, J.M.M., which has been forwarded to the appropriate department and from which you should receive a receipt in due course. There should be no objection to using the choke input arrangement to reduce the HT but it must be realised that there will still be some voltage rise during the no-load condition of the warm-up period. It is likely that this is the cause of most of the breakdown troubles you mention. The use of the selenium rectifier for the preamplifier fiilaments is an interesting approach to the hum problem, though, in most cases, it is sufficient to use suitable valves and bias the heater circuits a few volts positive with respect to chassis as was done in the "Playmaster" series.

J. G. (Geraldton, WA) writes to say that the article reprinted in the December, 1953, Radio and Hobbies concerning the use of echo sounding equipment for professional fishing has caused considerable interest in the local fishing fleet. Unfortunately suitable equipment is hard to get and very expensive and J.G. suggests that Radio and Hobbies may be interested in designing such equipment for home construction.

A.: We are pleased to hear that you found the article so interesting and we can appreciate how useful such a device would be. However, it seems unlikely that we will be able to describe the practical construction of such equipment. We also regret that we are unable to advise what is the market position on such equipment. We suggest that Amalgamated Wireless, 47 York St., Sydney, may be able to help you, since they handle a large range of electronic marine equipment. They may be able to p you in touch with RCA in America wh are apparently marketing equipmer based on the original German "Tisch lupe".

V.B. (Earlwood, NSW) wants us t explain the meaning electrolytic con densers which he noticed referred to i advertisements and technical articles.

A. The electrolytic capacitor uses a almuminium foil in a chemical solu tion, the foil being one plate and th electrolyte the other. The space betwee them which is essential to the capacitc is provided by a chemical film which th electrolyte forms on the aluminium. Th advantages are high capacitance in small space and at low cost, while th disadvantages are leaking current an suitability for use on DC only. Thi latter characteristic is the reason for th plus and minus sign. These devices ar used mainly as power filters where th leakage is of little importance com pared with the high capacitance so neces sary to hum-free operation.

M.C. (Point Lowley, SA) wants to know whether it would be possible to use power transformer as a modulation trans former coupling a pair of 807's in pus pull to a pair of 807's in parallel.

A. In order to answer your questio fully it would be necessary to know the operating conditions of both sets o valves. First the correct load for th push pull 307's would need to be de cided, taking into account the plat and screen voltages and operating con dition and referring to the valve manu facturer's data. Next the load presented to the secondary by the parallel 807's would need to be determined, this being calculated by Ohm's law from the plat voltage and current. The difference between these two impedances would be the impedance ratio required in the transformer and this would be equal to the square of the turns ratio. In the case of the transformer you describe the turns ratio from primary to one-half of the secondary would be 1.3 to 1.

Assume, as an example, that the fina operated at 600 volts and 150 mA. By Ohm's law this represents 4000 ohms and this would be reflected to the modulator as 5200 ohms by the above transformer. This would be reasonably close to the optimum load for a pair of 807's which were being well driven in a class AB condition.

G.B. (Leeton, NSW) forwards a subscription for Radio and Hobbies and comments on the various articles which have appealed to him in the past 12 months.

A. Thanks for the subscription G.B which has been forwarded to the appropriate department. Thanks also for your comments which are always helpful in determining the needs of our readers. We did consider your request for ideas re homemade sound effects but there did not appear to be a great deal of reader interest in the subject. However, if we receive some indication that others might be interested in it we will give the idea some more thought.

R.J.B. (Bellieue, Tas.) has a commercial 4-band short-wave receiver which is very noisy and wants to know whether anything can be done to improve the performance.

A. It is most likely that the noise is due to local electrical equipment rather than to the receiver and it is important to clarify this point before seeking a cure. If the noise stops when the aerial is removed it indicates that it is due to an outside source. If in the set, it will remain when the aerial is removed. If possible compare the performance with that obtained by a known good set in a similar location. If the noise is external it may be possible to help matters by using some form of shielded or transposed lead-in. Such a system was described in the July, 1953, issue of Radio and Hobbies. A few copies are still available. An article on binding Radio and Hobbies appeared in the May, 1940, issue and we may reprint this at some time.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to others readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 4/6. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

ONTROL UNIT FOUR

(Continued from Page 63)

d point in useful life for wide
e work.
out 3 grammes extra weight
added to the head to ensure
groove contact which may have
slightly worsened by the wear
he sapphire point. The total
ht would, therefore, be about
ammes.

e output of the amplifier was
ured across a 15 ohm resist-
load with an average reading
5 volts AC.

der these circumstances, the
ut from the entire system did
vary more than plus or minus
db from 40-15 Kc, the limits
e record. Maximum deviation
2 db at resonance, but with
tle more care in selecting load
tance, this might even have
reduced. There seemed little
, however, in aiming for any-
better than this.

e waveform viewed on an os-
scope showed no distortion vis-
to the eye from 15 Kc down
0 cycles. The 40 cycle trace
substantially a sine wave, but
how some break-up on its con-
.

is test not only showed the
-all quality of the entire equip-
, but illustrated that the cal-
ed curve for the Decca posi-
agreed almost exactly with the
ured performance. The dis-
ancies observed are most likely
to variations in the pick-up, and
in the record, which, never-
ss, was remarkably true to
.

e inference can fairly be drawn
the remaining curves are also
nable in practice.

DISTANT VHF SIGNALS

(Continued from Page 23)

eby effectively eliminating the
g associated with the atmos-
ic scattering process.

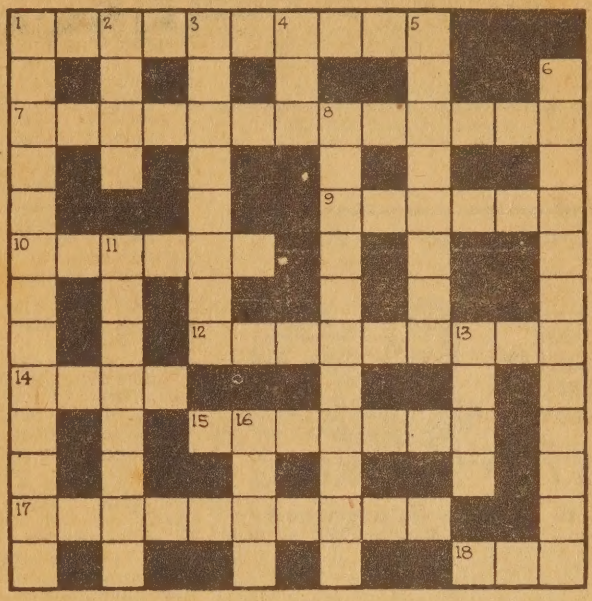
mountainous obstacle extending
above both the transmitting
receiving antennas requires the
waves to pass through the
turbulent and disturbing re-
s of the atmosphere at relative-
igh grazing angles.

ith these large grazing angles,
amount of energy received from
highly turbulent regions in the
ened lower portion of the at-
here is effectively eliminated
so, in turn, is most of the tro-
heric fading that normally
s on a non-obstructed path.

e of the experiments design-
o substantiate this theory was
ucted over a 30-day period on
Alaskan circuit between Yaku-
and Gustavous. The operat-
frequency was 38 Mc, and both
transmitting and receiving an-
as were 50 feet high.

uring the recording period, the
unt of energy delivered to the
iver was plotted against the
; the coordinates of the graph
r were also expressed in terms
ransmission loss v time. The
ntaneous transmission loss for
period varied by less than plus
is 2 db from a mean value of
oximately 134 db.

THE R. & H. CROSSWORD No. 4



ACROSS

1. Unit of capacitance
7. Detects radioactivity (two words).
9. Positive ion.
10. Type of battery charger.
12. A type of cell.
14. For cooling transmitting valves, (plural).
15. EMF
17. Test centre.
18. Distress call.

DOWN

1. Produced by permanent magnet.
2. Part of tuned circuit.
3. To repair.
4. Electric discharge.
5. Type of oscillator.
6. For sending and receiving.
8. Instability.
11. Used in relaxation oscillators.
13. Operating personnel of a ship.
16. Elliptical.

Solution and further crossword next month.

YOUR SIGNAL TRACER

(Continued from Page 47)

So much for the two cases.

There are plenty of possible uses for the tracer that we have not mentioned, and possibly a good many more that we haven't even thought of, but these will occur to you as you go on. As a matter of fact, if you do get any novel slants on the use of tracers we would be glad to know about them so that we can pass the information on to other readers.

You will probably want to add a few ideas of your own or modify the circuit to suit your own requirements in any case. For example, our tracer covers from virtually zero to about 1.75 Mc in the BC position. By cutting the coverage at the low end, you could extend the coverage at the high end to take in the full range covered by the oscillator in a normal broadcast receiver.

In some cases, too, a different short-wave coverage will be desirable. In our case, the oscillator inside the tracer covers from 7 to 19 Mc, making it possible to tune signals from 5 Mc to 21 Mc, but there is no reason why it should not be modified to suit individual requirements.

A metal case is essential if the tracer is to be used near strong stations to prevent signals getting into the tracer other than via the probe. To this end you will note that we have added a couple of bypass capacitors to the main leads as they come into the cabinet. The position is just the reverse of that in a signal generator where you try to prevent signals getting out of the instrument other than via the attenuator.

Last Month's Solution

C	H	O	K	E						B				
O		P		N	E	G	A	T	R	O	N			
U		E		D		R		R		N				
P	E	N	T	O	D	E		I		D		M		
L		C		D		E	B	O	N	I	T	E		
I		I	V	Y		N		D		N		T		
N	O	R		N			M	E	G	G	E	R		
G		C	U	E		P			E			I		
		U			E	L	E	C	T	R	I	C		
S	T	I	F	F		U			T		D			
O		T		U		G	A	L	E	N	A			
R	E	S	I	S	T	S			R		H			
T				E						S	O	S		

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Make £5 to £15 a week extra in spare time. Learn a modern Moneycraft at home. Special Postal Courses. Designs and Patterns FREE. Details from Dept. B., Le Bon College (regd.), Box 279 Haymarket, Sydney.

ABUNDANCE

Learn how to use **"thought-power"** for your needs. Send 7d. stamps for free "THOUGHT-CASTING" Booklet.

Benn, 24 Clarence Chambers, SOUTH GRAFTON, N.S.W.

Wanted to Buy, Sell or Exchange

Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for July issue of Radio and Hobbies is Wednesday, June 12th.

FOR SALE: Aegis KC4 tuning unit £25. K. Corcoran, 5 Albert St., Pascoe Vale. FX1613.

FOR SALE: M.S.P. Jensen 12in 10 watt P.M. Speaker, new, with x-former, £8 or offer. A. Hart, Railway Rd., St. Marys. NSW.

Smoking got you down ?

Here's an easy, safe way to conquer smoking before Smoking Habit conquers you. Inexpensive, reliable, quick

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Women STOP smoking as well as men

My Anti-Smoking discovery banishes all craving. Acts like magic, improves appetite, feel 1000 times better in health. Save money, be pounds better in pocket. Genuine testimonials from hundreds of delighted users.

WRITE FOR FREE BOOKLET.

Send for FREE BOOKLET, "How To Stop Smoking", with Special Application Form, and full details of what to do. Enclose name and address and 2 stamps for postage.

JACK ELWOOD, Dept. RH6/4

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